Mrs Hurst

TREATISE

ON SEVERAL

IMPROVEMENTS,

RECENTLY MADE IN

HOT-HOUSES.

ADVERTISEMENT.

Models as deſcribed in the Appendix to this work, are ſold at Mr DALZIEL's, *Chapel-Street*, *Bedford-Row*, *London*; or at Meſſ. DICKSONS AND SHADE's, *Edinburgh*; in whoſe nurſery may be ſeen a hot-houſe altered agreeably to this Treatiſe.

Wm. [illegible] Archt
Doncaster

A SHORT TREATISE

ON SEVERAL

IMPROVEMENTS,

RECENTLY MADE IN

HOT-HOUSES:

BY WHICH FROM FOUR-FIFTHS TO NINE-TENTHS OF THE FUEL COMMONLY USED WILL BE SAVED; TIME, LABOUR, AND RISK, GREATLY LESSENED; AND SEVERAL OTHER ADVANTAGES PRODUCED.

AND WHICH ARE

Applicable to Hot-houses already erected, or to the Construction of New Hot-houses.

Illustrated by Nine Large Copperplates.

BY J. LOUDON,

MEMBER OF THE SOCIETY OF ARTS, COMMERCE, &C. STRAND, LONDON:
AUTHOR OF OBSERVATIONS ON PLANTING, LANDSCAPE GARDENING, AND EMBANKING, &C.

DESIGNER OF RURAL IMPROVEMENTS.

EDINBURGH:

PRINTED FOR THE AUTHOR:

AND SOLD BY ARCHIBALD CONSTABLE AND CO. EDINBURGH;
LONGMAN, HURST, REES, AND ORME, LONDON.

1805.

John Turnbull, Printer, Edinburgh.

PREFACE.

NEARLY four months have elapsed since the improvements to be treated of in the first part of this work, were executed upon Dicksons' and Shade's hothouse. During this period they have been examined by a great number of respectable gentlemen, who, with scarcely a single exception, expressed their warmest approbation of the scheme, and strong convictions of its general utility. Among these gentlemen, were some who have paid particular attention to the subject, and they are decidedly of opinion, that the improvements here submitted, are calculated to be more extensively useful than any thing that has yet appeared.

E

Encouraged thus, to make them as generally underſtood as poſſible, the author has cauſed to be made *models in wood*, of certain parts which might perhaps puzzle ſome country artizans, who are not accuſtomed to work from plans. Theſe may be examined or purchaſed at the places mentioned in the advertiſement.

If required, models can alſo be made *of the new plan for growing pines—of the improved peach-houſe*, and *of the new pit*, which are deſcribed and recommended in this work.

The attention requiſite to ſhew and vend theſe models, has rendered it neceſſary for the author to deviate from the common mode of bookſelling.

CONTENTS.

PART I.

AN ACCOUNT AND TREATISE OF SEVERAL ALTERATIONS MADE UPON A HOTHOUSE BELONGING TO MESS. DICKSONS AND SHADE, EDINBURGH.

	Page.
INTRODUCTION, - - - -	9
GENERAL DESCRIPTION OF THE HOTHOUSE BELONGING TO MESS. DICKSONS AND SHADE, PREVIOUSLY TO ITS BEING ALTERED. - -	12
GENERAL DESCRIPTION OF THE SEVERAL ALTERATIONS, - - - - - -	17
OF THE FURNACE AND FUEL-CHAMBER,	
Of the furnace and fuel-chamber formerly uſed, - - - - - -	21
Deſcription of the improved furnace and fuel-chamber, - - - - -	23

Of

Page.
OF THE SMOKE-FLUE, - - - -
Of the flue before it was altered, - - 31
Of the improved flue, - - - - 32
OF THE AIR-FLUE, - - - - - 36
OF THE INTENTION OF THE ALTERATIONS UPON THE FURNACE AND FLUES, - - - 39
OF THE MODE OF USING THE IMPROVED FURNACE AND FLUES, - - - - - 54
Of managing the valves in the furnace and ash-pit doors, - - - - - 55
OF THE INNER ROOFING,
Of its construction, and the mode of fitting it to the hothouse, - - - - 65
Of the intention of the inner roofing, - 73
Of the mode of using the inner roofing, 80
OF THE AIR-PUMP, OR AIR-BELLOWS,
Of the different purposes for which air is admitted into hothouses, - - - 83
Of the construction of the air-pump and bellows, - - - - - - 90
Of the intention and mode of using the air-pump or bellows, - - - - 94
OF THE VENTILATOR,
Of ventilation, - - - - - 99
Of the construction of the ventilator, - 107
Of the intention and mode of using the ventilator, - - - - - - 111

OF

Page.
OF THE ADVANTAGES RESULTING FROM THESE IMPROVEMENTS, - - - - - - 116
Of the advantage, in the case of DICKSONS AND SHADE's Hothouse, - - - 117
On the advantages which will result in general cases, - - - - - - - - - - 123
OF THE EXPENCE OF MAKING THESE ALTERATIONS, WITH REFERENCES TO WORKMEN WHO CAN BE SENT TO EXECUTE THEM UPON HOTHOUSES TO ANY PART OF THE COUNTRY. - - - 127

PART II.

ON OTHER IMPROVEMENTS WHCH MAY BE MADE IN HOTHOUSES.

OF THE INTRODUCTION OF IMPROVEMENTS IN HOTHOUSES, - - - - - - 135
OF ADDITIONAL IMPROVEMENTS IN THE MODES OF HEATING HOTHOUSES, - - - 145
OF HEATING HOTHOUSES BY STEAM, AND OF STEAMING IN GENERAL, - - - 157

CONTENTS.

Page.
OF A NEW PLAN FOR GROWING PINE APPLES, 165
OF AN IMPROVED PIT FOR GROWING YOUNG PINES, RAISING CUCUMBERS, MELONS, &c. - 178
OF AN IMPROVED PEACH-HOUSE, 186
OF ARCHITECTURAL DECORATIONS IN HOTHOUSES,
CONCLUSION, - - - - - - - - - - 202
EXPLANATION OF THE PLATES, - - - - 205
POSTSCRIPT, - - - - - - - 244

ERRATA.

Page 149, line 3, dele *to the*
—— line 5, for *from* read *to*
159, —— 4, before *ſome* read *an account of*
195, —— 19, after *training* read *upon*
200, —— 17, for *panes* read *frames*.

Some other errors which do not alter the ſenſe, and in particular an erroneous enumeration of the chapters, the reader is intreated to paſs without cenſure.

AN

ACCOUNT

OF

SEVERAL ALTERATIONS, &c.

INTRODUCTION.

It was the original intention of the author not to have printed any thing respecting these improvements until he published his treatise on *Hothouses*, *Hotwalls*, &c. This treatise was intended to be pretty full—to be printed in quarto, and to contain many new designs—with an Appendix, containing numerous criticisms upon hothouses erected in different parts of this island. He is however induced to keep back this work at present,

 partly

partly from want of time to ſuperintend the preſs, partly from a deſire to try the ſucceſs of ſeveral other new and equally important ſchemes before he ſubmitted them to the public, and partly alſo, that he might enlarge the number of criticiſms, by viewing and examining ſome hothouſes which he has not yet had an opportunity of ſeeing, but which he expects to ſee in the enſuing ſeaſon, in the courſe of an intended tour through the iſland.

On the other hand, the author has been induced to write this account, from the advice of ſeveral intelligent gentlemen who conceive highly of its utility, and at the deſire, and for the benefit of a very conſiderable number who have already begun to alter their hothouſes according to this plan; and in ſome degree alſo from a reaſon, the detail of which would reflect no great honour upon a certain claſs of men. The thing alluded to, however, is juſt what the author

author expected, from the sudden introduction of a plan which strikes at the root of some of the most important points of general, and even much approved practice, in the construction of hothouses. But in consequence of the superior nature and advantage of his scheme, he has nothing to fear, and rests perfectly satisfied, that in this liberal and improving age, these alterations will meet with general approbation, and be adopted according to the degree of their real utility —and this too, not the less readily, because, at first, they may be decried, or opposed, as all the most useful discoveries in other branches of science or of art have been, by some interested, ignorant, and little minded men.

GENERAL DESCRIPTION OF THE HOTHOUSE, BELONGING TO MESS. DICKSONS AND SHADE, UPON WHICH THE IMPROVEMENTS WERE MADE.

The hothouſe upon which theſe alterations were made, was built about three years ago, from a plan given by the author, according to the moſt approved and economical mode of building hothouſes at that time. It anſwered the intention very well; and indeed, from ſome particular circumſtances to be mentioned, fully better than moſt hothouſes; for being of a ſmall ſize, and the ends being built of ſolid wall, which is always warmer than glaſs, it was heated by the flues with more than common eaſe, and this heat, from the ſame circumſtances, was retained for a more than ordinary length of time.

But

But in order to give the reader more clear ideas, it may be neceſſary to obſerve in the way of deſcription, that this houſe is twenty-three feet long, fourteen feet broad, ten feet high in the back wall, four and a half feet high in front, (inſide meaſure;) that the two ends, back and front, are built of maſon work, and three feet of the ſlope at the top of the houſe is covered with deal—the reſt of the ſlope with eleven ſaſhes, glazed with what is called fragment glaſs, being old ones formerly uſed for another purpoſe, and fitted up here for the ſake of economy.

The furnace, or fire place, was placed at the north-eaſt corner, in a maſs of brick-work, four feet broad, four feet deep, and which projected three feet from the wall in the uſual manner.

The flue in the inſide of the houſe was led firſt along the front, and then round at the bottom of the back wall, and entered a ſhaft, or chimney, immediately above the furnace.

The

The houſe was uſed for forcing flowers, &c.; and hence the flue ſurrounded a *bark* or *tan* pit, which reached within four feet of the glaſs behind, and eighteen inches of it before.

From this deſcription the reader will be aware, that this hothouſe is very ſmall, and conſequently unfavourable for ſhewing the effect of the improvements which have been made, on the three following accounts:

1. It was ſo eaſily heated by the common mode.

2. Having no glaſs in front, nor in the ends, but only in part of the roof, the heat raiſed was longer retained, than happens in the caſe of any ſmall hothouſe, having glaſs on the ends and front, as well as the roof.

3. A ſmall hothouſe, in all caſes, conſumes

ſumes a greater proportion of fuel than a large one, as in dwelling-houſes is well known to be the caſe with ſmall, in comparison with large rooms.

UNDER theſe diſadvantages, it may appear ſurpriſing to ſome, that the author fixed upon this houſe as a ſubject of improvement. It is true, indeed, he could have made the alterations upon many gentlemen's hothouſes, with a much greater effect; but he judged it better for the public to execute them in ſome nurſery, (a nurſery being a kind of public place,) where they might be ſeen and examined by gentlemen with greater freedom. And though this hothouſe belonging to Meſſ. Dickſons and Shade, is far from being the beſt in the nurſeries about Edinburgh, he preferred it, becauſe (from ſome knowledge of moſt of the nurſeries and nurſerymen in Scotland, and that of a more cloſe and intimate kind than generally

nerally can be the cafe with landed gentlemen,) he is induced to give this company the preference on moft occafions; and he can, without the leaft hefitation, recommend them to the gentlemen of this country.

GENERAL DESCRIPTION OF THE SEVERAL ALTERATIONS.

IN the following pages they ſhall be deſcribed and treated of, in an order, correſponding in ſome degree, with their importance: *viz.*

1. The *furnace and fuel-chamber* in which the coal or other fuel is conſumed.

2. The *ſmoke-flue*, which conducts the

ſmoke round the houſe, to the ſhaft or chimney by which it eſcapes.

3. The *air-flue*, which collects heated air around and near the furnace, and conveys it to the oppoſite end of the houſe.

4. The *inner-roofing*, being a coarſe flannel curtain let down under the glaſs, during night, to prevent the air of the houſe from coming in contact with the glaſs.

5. The *air-pump or bellows*, intended for pineries and ſtoves, to force or draw in freſh air of moderate temperature, during the winter months. This air can generally be obtained from the *back ſheds*.

6. The *ventilator*, intended either to put the air of the houſe in motion during the day; or

at

at pleaſure; and thus to imitate the natural breeze.

After thus deſcribing and treating of theſe alterations, and the intentions, and uſe of each of them ſeparately, ſome obſervations will be added under the following heads: *viz.*

1. On the advantages reſulting from theſe alterations.

2. On the expence of making them, with ſome hints to gentlemen intending to alter hothouſes according to this plan; and references to workmen in Edinburgh who underſtand the practical parts of theſe improvements.

3. On other improvements which may be executed on hothouſes.

Among other things in this chapter, will be ſuggeſted new plans for pine-ſtoves, peach-houſes, and pits, which the author conceives, will, be conſiderable improvements.

CHAP.

CHAP I.

OF THE FURNACE AND FUEL-CHAMBER.

SECTION I.

Of the Furnace and Fuel-chamber formerly used.

BEFORE the alterations were made, the furnace, as already mentioned, and as is generally done, was placed in a large mafs of brick work attached to the houfe. Its chamber or fpace for containing the fuel, was

was *two feet* long, *eighteen inches* wide, and *eighteen inches* high.

The furnace-door, a ſingle plate of caſt iron, ten inches ſquare.

The floor, or bottom of the fuel-chamber, had five iron bars which formed a grate, fourteen inches long, and ten inches wide; having a dead or ſolid ſpace of four inches on the two ſides, and ten inches behind, or in the farther end of the chamber. Theſe dead ſpaces were intended for the purpoſe of making the fire burn ſlowly, and laſt long, agreeably to the principle recommended and practiſed by Mr Nicol *.

The aſh-pit was eighteen inches long, and ten inches wide, and without any door.

* See The Forcing Gardener, 3d Edit. pub. 1802.

SECTION II.

Defcription of the improved Furnace, and Fuel-chamber.

A FURNACE was made fo far fimilar to Count Rumford's that it had double doors, but different in all other refpects: for,

1. The outer and inner doors were almoft exactly of the fame fize, and confequently, the fides were nearly at right angles with the front, which is a very great advantage in fixing it in mafon work.

2. It contained one opening in each of its fides, for the purpofe of communicating with the air flue to be afterwards defcribed.

3. It has a valve in the centre of the outer door: and,

4. It has four nobs or projections at the corners, which are for the purpose of fixing it in the building. These and the other parts will be best understood from plate I. fig. 1.

The size of the furnace door used is *seven and a half inches*, which is sufficiently large for this house, though too small for general and convenient use.

A door ten inches square, with a valve in it, was also got for the ash-pit. See plate I. fig. 2.

The mass of brick work, containing the old furnace and ash-pit, being taken down, the bricks and the five metal bars were reserved to be used in building up the new furnace.

It

It is worthy of remark here, that of all the old materials, the furnace door alone was not re-ufed; and this, not becaufe it would not anfwer, but merely to try the effects of one with a valve. But a furnace door with a valve in it, is by no means effentially neceffary, and in general gentlemen who make alterations according to this plan, may very fafely ufe the old furnace door as a door to the new afh-pit, in place of fending for a new one with a valve.

A large hole being made in the lower part of the wall of the houfe, the new afh-pit and furnace were built under it, projecting fo far into the houfe, as that the outer furnace door, and the door of the afh-pit, were even, or "flufh" as workmen term it, with the outer face of the wall.

The afh-pit was made fourteen inches long, and ten inches wide: and,

The old bars were laid above it, form-

ing the grate, and chamber for the fuel. The furnace was then properly placed, and the grate built round, (except at the neck of the flue, which was of courſe kept open,) with bricks laid flat, that is " brick on bed," as ſhewn plate I. fig. 3.

This building was carried up twelve inches, and then arched over in the uſual manner. Over this arch was made another of the ſame thickneſs, preſerving a vacuity betwixt them of three inches, which vacuity joins with each ſide of the furnace door, in order to communicate with the holes or openings formerly mentioned, and as ſhewn in plate I, by figures 3, 4, and 5, which are tranſverſe and vertical ſections.

In examining theſe two ſections, ſome things will be ſeen which deſerve attention.

In

In figure 3, the contraction of the air vacuity at *g* and *h*, is made for the purpose of confining and stagnating the air, in order that it may be thoroughly heated before it passes along the air flue into the house.

The valve in the furnace door, and also the holes in each side, which communicate immediately with the vacuity, are also made small, in order that a large body of cool air may never be admitted at once. For it is a fact, that were the vacuity, valves, and air flue, every where of equal width, the air would pass rapidly through into the house scarcely heated at all; unless, perhaps, when the fire was very strong and the furnace door red hot.

It may be observed here, that the arch over the air vacuity, can be supported upon the under one, by making the ends of two or three of the bricks project down and rest upon

upon the top of it, as ſhewn in figure 4; or two or three pieces of brick or ſtone laid carefully upon the under arch, will ſerve the ſame purpoſe.

But there is no abſolute neceſſity for ſuch ſupports; the intention is merely to guard againſt the ſinking of the upper arch.

It is needleſs to add what every maſon or bricklayer knows, that theſe arches can eaſily be "thrown" or built, by filling the fuel-chamber with earth, or by laying in bricks or any ſuch looſe materials, which can be taken out as ſoon as the mortar hardens ſo as to leave the arch entire.

The arch above the vacuity can eaſily be made in the ſame manner.

In figure 5, the large chambers *i* and *z*, and the contraction at the beginning of the

the air flue *k*, are for the purpoſe above mentioned. There is no neceſſity for theſe chambers being in every caſe ſo large as ſhewn in the plate; although a proportion ſomewhat ſimilar, will generally be found preferable.

In figure 5 alſo, a ſmall receſs will be obſerved betwixt the grate and the flue, for the purpoſe of preſerving a portion of the fuel which ſhall burn ſlowly; and thus it is preſumed live-coals may be had from that receſs for twenty-four hours after the fire is kindled. Some may think that a plain dead ſpace larger than this receſs would ſerve equally well; but this on examination will appear an ill founded idea; for if we obſerve the dotted line, *m n* in the plate, it will appear that it could not preſerve the coals alive for a ſufficient length of time, unleſs the throat of the flue were made much more upright; which on the other hand would preſerve

preſerve too much fuel, and very much prevent the heat either from paſſing through it into the air vacuity, or onwards into the ſmoke flue.

This improvement I did not think of when the furnace at Dickſons and Shade's hothouſe was built; but I now ſee from the fires then being ſometimes totally extinguiſhed in the mornings, that it will be a beneficial addition to the plan.

CHAP. II.

OF THE SMOKE FLUE.

SECTION I.

Of the Flue before it was altered.

As already mentioned in the general description, the direction of this flue was round the house. It was built, very properly, upon supports *, and totally detached from the

* Mr Nicol always builds his flues upon supports, for which he deserves credit: the practice is totally unknown in several parts of England, and not sufficiently attended to by some in this country.

the front wall, or any other building, which is alſo an important point to attend to.

But though there was ample room to make the flue of conſiderable depth, this was neglected, which is a very great, but univerſal error. Still, however, the depth of three bricks placed on edge was allowed, that is about fifteen inches, which depth is not always given, for we find even ſome planners and others, who though they generally build their flues of this depth, yet contend that the breadth of two bricks is perfectly ſufficient.

SECTION II.

Of the improved Flue.

THIS old flue was taken down, and built up *five bricks in breadth*,—as great a depth as in this caſe, could be accompliſhed.

"Briggs,"

" Briggs," or perpendicular partitions, reaching from the covers till within a brick and a half of the bottom, were formed by placing bricks acroſs, and joining the two ſides of the flues.

The firſt of theſe, was placed twenty feet from the furnace, and the reſt about ten or twelve feet diſtant from one another, as ſhewn in figure 1. plate II.

Theſe " briggs" divide the flue into chambers, or compartments, each of which will naturally be completely filled with ſmoke and heat, before any can occupy the next; and, hence the whole flue muſt be completely filled, before any can eſcape at the chimney top.

The flue is made of five bricks breadth in depth, at both ends, and along the front of the houſe, and in this ſpace it had three briggs, or partitions, *viz.* two in the front, and one

in that end fartheſt from the fire. For to have made one in the end where the fire enters, would have had a tendency to make that part of the houſe too warm.

The back flue was made of the ordinary depth, with only one projection, placed at its termination, immediately before the ſmoke aſcended into the ſhaft or chimney.

Had the houſe been large, the whole length of the flue ſhould have been made as deep as poſſible; and a conſiderable depth may generally be obtained, particularly in pine or plant ſtoves, or even in vineries and peach houſes, when theſe are trained under the ſloping glaſs.

But in almoſt every caſe that may occur, when vines are trained upon the back wall, it will be improper to make the flues deeper than three bricks; yet even here, the "briggs" ſhould be made to reach the ſame

ſame depth as before, that is, within a brick and a half of the bottom of the flue.

Or, the flues in ſuch houſes may be made of double width, or as wide as can be conveniently accompliſhed, and the " briggs" may be carried up from the bottom, leaving a ſmall hole in the foundation of each brigg, of twelve inches long, by four inches wide, or larger, according to the ſize of the furnace. Through this hole the ſmoke will paſs from chamber to chamber.

The air flue, built upon the top of ſuch flues as this, need only be its full breadth from the furnace to the firſt compartment; afterwards it may be carried on in a narrow flue, or in an earthen or plate-iron pipe, to the end of the houſe. But of the air flue in next ſection.

In the middle of the ſhaft is placed a damper, the intention and mode of uſing which ſhall be preſently explained.

CHAP. III.

OF THE AIR-FLUE.

THE vacuity around the fire-place is continued on each ſide, and over the top, as well as under the bottom of the ſmoke flue, for about four feet in length, as ſhewn in plate I. by figures 4 and 6.

The two ſide and bottom vacuities, are continued no farther, but there unite with the ſpace at top, which top ſpace is continued on, as an air flue to the oppoſite end of the houſe. And there it terminates, allowing the heated air to eſcape, as ſhewn plate II. fig. 1.

The

The top of the ſmoke flue ſerves for the bottom of the air flue, which is one "brick on edge" in depth, and covered with tyle or pavement ſimilar to the ſmoke flue.

A ſtone or brick neatly fitted to the end of the air flue, ſerves to cloſe it up when requiſite.

Both the air and ſmoke flue, were plaſtered in the outſide for the ſake of appearance, as the bricks were very coarſe and unſightly; but in the inſide of the flue, this was, and ought always to be avoided if poſſible, as plaſter is a non-conductor of heat.

But had the bricks been equally neat and beautiful with thoſe made in the neighbourhood of London, no plaſter work would have been neceſſary: the joints would have been neatly puttied of the ſame colour as the brick, and at moſt a coat of paint of a brown or cream colour, would have been given,

given. For it is preſumed they have no good taſte who prefer to this ſtyle, walls and flues covered with white plaſter, the raw glare of which when oppoſed and interſperſed among the delicate green of vegitation, has a harſh and unharmonious effect.

Having thus endeavoured to deſcribe the alterations made upon the furnace and flue, which it is hoped by the aſſiſtance of the plates, will be underſtood by the reader, and by intelligent workmen, ſome obſervations ſhall next be added reſpecting the intention of theſe alterations.

CHAP. IV.

OF THE INTENTION OF THE ALTERATIONS UPON THE FURNACE AND FLUES.

In the *first* place, the particular intention of this furnace is to consume or ignite the fuel as quickly as possible. For this purpose no dead space is left on each side, as in Mr Nicol's improved furnaces; but on the contrary, the grate occupies the whole breadth of the chamber, in order that no part of the fuel may remain unkindled. At

the

the ſame time a receſs under the throat of the flue is made to preſerve ſome live-fuel in order to rekindle the fire.

Secondly, The depth of the flue is intended to produce a greater maſs of brick work, to be heated at the leaſt expence, which heated maſs will continue longer to give out heat to the houſe, and thus by making one fire ſerve in place of a number, will conſequently ſave much time, and produce a more ſteady heat; an advantage independent of the ſaving of fuel.

In ſome caſes breadth may be uſed in place of depth, and then the briggs may be literally diviſions, or partitions, each with a hole at bottom, ſix or eight inches ſquare: or of the dimenſions given laſt chapter.

Thirdly, The briggs are intended to heat this maſs more uniformly and effectually, by ſtagnating the ſmoke. And as the hotteſt of that

that contained in each compartment, will always riſe to the top, ſo the coldeſt, will in the ſame way be forced out under the partitions. What was the coldeſt ſmoke of the firſt compartment, will be the hotteſt of the next; of courſe it will aſcend and preſs out that which is ſtill colder, and thus will the ſmoke paſs through the ſeveral compartments until it has given out the greater part of the heat which it contains, and at laſt, when quite cold, it is forced up the ſhaft, or chimney.

Beſides this very great advantage, theſe briggs, or partitions, are alſo found to increaſe the draught of the fire.

Fourthly, The double furnace-door, and the vacuity around the furnace, are intended to collect that heat, which in other furnaces is totally loſt in the adjoining maſs of maſon work.

Fifthly, This vacuity is alſo continued around the flue for the diſtance of ſome feet from the furnace, in order to collect a quantity of heat, which would otherwiſe, as is generally the caſe, make that end of the houſe conſiderably warmer than the other, or oppoſite end.

Sixthly, The vacuity, or air flue, continued from thence along the top of the ſmoke flue only, is intended to convey the heated air collected as above, to the other end of the houſe: Which part of the houſe being fartheſt from the fire, is, in general, too cold; but by this means it is rendered equally warm with the other.

Some may think that when two fires are uſed, one being placed at each end of the houſe, the temperature would be regular, and the heated air would be allowed to eſcape from the furnace immediately into

into the houſe. But without ſtating any of the many and great arguments againſt this, it is ſufficient to obſerve, that according to this new plan, in no caſe whatever, will two fires be neceſſary. It will always be found more economical to augment the ſize of the furnace, in proportion to that of the houſe to be heated.

CHAP. IV.

OF THE MODE OF USING THIS FURNACE AND THE FLUES.

SUPPOSE the fire lighted, and the fuel thrown in, the furnace doors are to be ſhut cloſe, and alſo the valve in the outer door turned round, ſo as not to admit any air. But the aſh-pit door, and the damper within the houſe, muſt be thrown open.

As

As ſoon as the groſſer part of the ſmoke is diſſipated, and the general maſs of fuel becomes nearly red hot, or almoſt covered with flames, which, in an ordinary furnace, will generally happen in twenty minutes, or half an hour, after the fire is kindled,—cloſe the aſh-pit door, open the valve in the outer furnace-door, and ſhut the damper.

Theſe operations produce the three following effects, *viz.*

1. The fire is preſerved ſtationary; that is, the fuel is no longer conſumed with the ſame degree of rapidity.

2. The whole heat generated, is ſtagnated in the flue.

3. The cool air entering by the valve, is rarified, partly on the furnace door, but principally in the vacuity around the furnace,

nace, and thus is preſſed forward into the houſe.

The fire being preſerved in a good degree ſtationary, the great heat which is contained in the fuel now red hot, does not enter the flue to make a violent irregular heat in the houſe, but it heats the air in the vacuity which ſurrounds it.

This heated air being allowed to paſs into the houſe, is a more ſpeedy, effectual, and uniform way of heating it; becauſe it mixes at once with the air already in the houſe, whereas by the common mode, every particle of the air contained in the ſame, muſt come in contact with the flue before the houſe is properly heated. Now, to allow time ſufficient for this proceſs, the fire muſt be kept burning for a very conſiderable time, and no ſooner is the degree of heat requiſite obtained, than the flue, ſtill as hot as before, and now aid-

ed

ed by the ſun upon the glaſs, raiſes the temperature to a height greatly beyond that which was required. This is particularly the caſe, as every gardener knows, during the mornings of the winter and ſpring months. The apprentice lad, or in ſome caſes the maſter himſelf, comes to the hothouſe, perhaps at ſeven o'clock in a clear froſty morning, in the end of January; he finds the thermometer ſtanding ten or fifteen degrees below the proper or required temperature. To remedy this, he with all ſpeed puts on as large a fire as poſſible— perhaps it is well kindled by eight o'clock, but no heat is yet added to the houſe; on the contrary, much heat has been eſcaping from it, and the thermometer is now ſix or eight degrees lower than before. About half paſt nine o'clock, and not always ſo ſoon, the thermometer indicates the proper degree of heat. Though the air be froſty, and the morning ſtill cold, yet now the ſun-beams dart upon

upon the glaſs with much vigour; and about twenty minutes, or half an hour paſt ten, the thermometer is ten or twenty degrees higher than the proper medium, and continues to riſe with rapidity. At eleven the houſe is at an alarming degree of heat, and no alternative remains for the lad, but to let down the ſaſhes, in order to admit freſh air; for though he had juſt before opened the furnace doors, its effects are comparatively much ſlower.

Now it is evident, that no ſooner are the ſaſhes thrown down, however little a ſpace, than the gravity of the clear "froſty" air of the atmoſphere, ruſhes into the houſe, and forcing out the light heated air, which at any rate has a continual tendency to aſcend, occupies the houſe in a few ſeconds. Thus the plants are brought in one moment from the climate of the torrid zone, to that of the polar regions.

In

In the mean time, the furnace door being thrown open, the cool air entering and rushing through the flue, makes it as cold in an hour as it was before the fire was put on. And again, perhaps ten or fifteen minutes after the sashes were opened, the lad perceives, (for he is under the necessity of being always upon the watch,) that the house is too cold—instantly he draws up the sashes, stirs up the fire, and shuts the furnace door. What is the consequence? The joint effects of the sun, now more powerful than before, and the fire, which not being fully exhausted, is easily rekindled, produce the same extreme as formerly! The same remedy is applied, which again is attended with the same baneful consequences, to vegetation. This rotation of extremes goes on almost without interruption, in the pineries and stoves, every sunshine day, during three quarters of the year, and in vineries peach-

houſes, &c. during the beginning of the forcing ſeaſon *.

The bad conſequences which reſult from this practice, it may ſafely be ſaid, are incalculable.

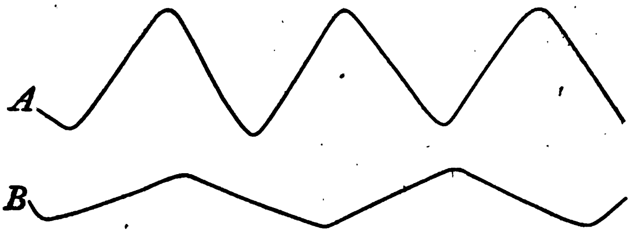
The above will no doubt be agreed to by every one ſo far; but perhaps when it is ſaid, the one extreme is as the torrid, the other as the frigid zone, it will be denied; for it will be ſaid, the thermometer in the hothouſe, never is ſeen ſo low, as even in the open air. But this, like many other common ideas, ariſes from want of due

* I had the moſt complete opportunity of knowing this, about eight years ago, when I was aſſiſtant to the late MR MAWER, PLANNER and NURSERYMAN, DALRY, near Edinburgh. I ſaw it happen every day in his own hothouſes, which, as is well known, were at that time, the moſt extenſive, and beſt conſtructed in Scotland. Several particulars reſpecting theſe hothouſes, and particularly about the extenſive ſteam operations then carried on, will appear in the treatiſe on Hothouſes.

due consideration of the subject, and from ignorance of the doctrine of heat.

For, it is evident that the extremes of heat in the house, being so much more rapid than the motion of the mercury in the thermometer; the highest or lowest degree of these extremes, can never be indicated, owing to the impulse of the succeeding extreme, counteracting the true indication of the former one. For it is well known, that a thermometer in air takes several minutes to indicate the true temperature of the medium in which it is placed.

Hence, to be short, if the real temperature of the extremes in the house are as the line *A*, the temperature indicated by the thermometer will be somewhat corresponding to the line *B*,



 two

two lines very different when obſerved ſeparately.

It may be ſafely ſaid, that in three minutes after the ſaſhes are let down, the houſe is of the ſame temperature as the atmoſphere: At that temperature, it remains until the thermometer about to indicate it, is checked by heat, ſuddenly generated by the ſun and the flue.

From this ſhort ſtatement of what really happens, the ſickly appearance, and debilitated habits of hothouſe plants, compared with the freſh robuſt luxuriance of thoſe reared in the open air, will not appear ſurpriſing; and the frequent failure of crops of fruit will be perfectly accounted for.

But the evils recounted can never happen with furnaces and flues, built according to the plan recommended; becauſe,

In the *firſt* place, The temperature of the

houſe

houſe when heated by fire alone, will be at all times ſo uniform as to render great exertions to counteract any extreme totally unneceſſary; and,

In the *ſecond* place, Suppoſing the houſe at the required temperature, and a briſk fire in the furnace at the time, (a caſe by the bye that could ſeldom or never happen;) if the valve in the outer furnace door is cloſed, and alſo the aperture at the extremity of the air-flue, the heated air will be completely ſtagnated, and the greater part of the heat will be confined in the furnace and the air-flue, to be let into the houſe when wanted. It is true, indeed, that a certain quantity of heat will eſcape through the maſon work, notwithſtanding theſe operations; but this will be ſmall comparatively with what happens in the caſe of common flues, for this particular reaſon, that air (in this caſe, the air of the air-flue) is

the

the very worſt conductor of heat known: But ſuppoſing that any thing like an over-heat ſhould occur, it can be completely over-balanced at once; and without chilling the plants in the leaſt degree, by the air-pump, as will be ſhewn in the proper place.

CHAP. V.

OF MANAGING THE VALVES IN THE FURNACE AND ASH-PIT DOORS.

Two or three directions on this subject are thrown into distinct heads for the sake of gardeners, who, it is to be observed, may be apt to go considerably wrong, until they have a just idea of the effects of the valves; and

and particularly of the one in the outer furnace door.

1. If the houſe is filled with heat to the proper degree, the fire extinguiſhed, and the flue and furnace quite cold, no evil can ariſe from having the valves in the aſh-pit door, or even the door itſelf open: And the ſame may be ſaid reſpecting the damper.

2. If the houſe and flues, *&c.* be in the ſame ſtate as above, no great evil can ariſe from having the furnace door, or its valve, open; becauſe ſuch is the ſtationary nature of air, (ſo to ſpeak,) particularly in ſuch an intricate, lengthened, and horizontal confinement as this, that it will not enter the houſe through the vacuities, and the air-flue.

Theſe two caſes apply principally to the ſummer months, and are comparatively of little importance. But,

3. If

3. If a ſtrong fire is put on in the afternoon or evening, and the aſh-pit valve, or the aſh-pit door itſelf, be left open during the night, the fire will be ſoon exhauſted, and the houſe cooled. Care, therefore, muſt be taken to keep it ſhut at all times through the night, and always through the day, when the fire is in a proper ſtate for ſhutting in the damper.

It is proper to notice here, however, that the briggs, for ſimilar reaſons to thoſe given in direction 2d, will prevent the flue from being half ſo much cooled, as is the caſe in common furnaces and flues.

The valve in the aſh-pit door, it may be obſerved, is of no eſſential uſe; for the door itſelf can be opened, more or leſs, according to the freſh air wanted for the fire. This valve is principally neceſſary in large houſes, when a ſmall quantity of air may be admitted to enter by the furnace,

forcing an equal quantity of ſmoke off, by a ſmall opening at the damper, and at the chimney top. This opening is left by not ſhutting the damper quite cloſe. But theſe operations are unneceſſary in a ſmall houſe, and can ſeldom indeed be done without conſiderable loſs of heat.

4. If a ſtrong fire is put on in the afternoon, and when the aſh-pit and damper are cloſed, the valve in the outer furnace door is left fully open; the houſe will be rendered too hot at the beginning of the night, and too cool before morning; for the air will continue to ruſh in until it has nearly cooled the fire place. But it deſerves to be remaked as above, in direction 2d, That ſuch is the ſtationary nature of air, and particularly in ſuch an intricate lengthened and horizontal confinement as this vacuity, that

that though the valve was left fully open, the houſe would not be greatly cooled *.

Obſerve, that it is more ſafe to turn it round, ſo as to leave an opening about one fourth of the full ſize. This will keep a ſmall, but uniform current of air entering the houſe during the whole night.

5. In the morning when the fire then put on, is ſo far conſumed or kindled, as to be in a ſtate fit for cloſing the aſh-pit door and the damper, if the temperature of the houſe is much too low, open the valve fully; but if it is not required to raiſe the temperature much, then open it one half only. Shut it entirely if the houſe is ſufficiently hot,

* Nothing like what ſome have experienced, who have placed large plate iron pipes acroſs the chamber, with one end in the houſe, and the other in the open air. See Evelyn's Account of his Conſervatory, in the 10th edition of *Kalendarium Hortenſe*.

hot, or open it, and while heated air is admitted, pump in cool air to lower the temperature of the houſe.

Theſe directions, it is to be feared, will give ſome an idea that this furnace and air-flue, are of too intricate a nature for general practice; but, the contrary may be ſeen at Dickſons and Shade's nurſery. And the whole alterations will, wherever they are eventually executed, be found to give much leſs trouble than the common furnace and flues.

6. This may be a proper place to obſerve, that, from the experience of the above hothouſe, in January and February laſt, in ſevere weather, one fire put on in the afternoon, twenty or thirty minutes before the men gave over working—was ready for ſhutting the aſh-pit and damper, and turning the valve one fourth open at that time,

time, and that this fire ferved until next morning. That a fmall fire put on in the morning, and managed as above directed, (fee direction 5.) lafted 'till the afternoon. That in mild weather, one fire put on in the afternoon, lafted for twenty-four hours.

In that furnace in Dickfons & Shade's hothoufe, no recefs, as advifed, is made for preferving live-coals to rekindle with, yet when the fire is not too much exhaufted, by throwing in a fhovel full of coals or afhes, before the damper is fhut in, it can be lighted perfectly from the red afhes next morning.

From the very fmall fize of this furnace, and from the gardener allowing the fuel to be too much confumed before he fhut in the damper, it was, when firft tried, generally extinguifhed in the morning; but, by taking care to fhut in the damper as foon as the groffer fmoke was expelled, it has remained in a ftate proper for being re-

kindled

kindled for twenty hours, and had it been of ſuch a ſize as is repreſented in the plate, I ſhould ſcarcely think the receſs neceſſary.

Every gardener knows, that in kindling the fire from the aſhes, the live coals muſt be drawn over the grate to the front of the furnace, and the freſh fuel thrown in immediately behind them.

It may be remarked here, that when a few coals are thrown into the furnace in the evening, immediately before ſhutting in the damper, the fire is lighted with uncommon eaſe next morning. The mere opening of the aſh-pit door and the damper, has frequently made it blaze without being ſtirred up. This is owing to the preſence of the betuminous part of the coal, which could not be carried off in the form of ſmoke, becauſe, by ſhutting in the damper, &c. no freſh air was allowed to come in contact with it.

CHAP.

CHAP. VI.

OF THE INNER ROOFING.

SECTION I.

Of its Conſtruction, and the Mode of Fitting it to the Houſe.

THE inner roofing is ſimply a collection of curtains of coarſe woollen cloth, which are made ſo as to ſlide down upon wires, ſix or eight inches within the glaſs.

These

Theſe curtains can be drawn up, and let down at pleaſure, by means of cords and pullies. Each curtain may be made ten or fifteen feet broad, and of ſuch a length as will reach from the top down the ſlope and upright glaſs, to the front wall.

Along the one end of each curtain is attached a rod of wood about an inch or two inches ſquare, and the other end is fixed to the top of the houſe: or, in ſome caſes, to the bottom of the upright glaſs. This is done—either by ſimply nailing on the edge of the curtain; or by fixing it previouſly upon a piece of wood, which wood can be fixed up, and may be taken down, along with the curtain whenever the inner roofing becomes unneceſſary.

Whatever be the breadth of the curtains, each has along one edge a row of hooks, about two feet aſunder, and at the other edge, a ſtripe of cloth, ſix or eight inches broad,

is

is left unfixed at top, and without being attached to the rod at bottom: which is by way of overlay, to be ufed after the curtains are let down. In the edge of this overlay are fixed rings which are intended, in conjunction with the hooks, to fix and join the curtains together after they are dropped. The overlay, rings, and hooks, *&c.* will be feen in fig. 1. plate III. where *a a* is the overlay, *b b* the rings, *c c* the hooks, *d d* the cord, and *e e* the rod fixed to the end of the curtain.

There are too ways of ufing the cords and pullies, which fhall be defcribed.

In the *firft* way, a row of rings are fixed about eighteen inches afunder, in a line down the centre of the curtain. Through thefe rings a cord is paffed and fixed to the rod of wood at bottom, as is fhewn in plate III. fig. 1. The other end of the cord is paffed through a fmall hole in the upper end of the curtain, and (after the

curtain is fixed) from thence over a pulley to a pin or hook, as ſhewn in fig. 2. plate III. During the day, when this curtain is "tucked" up, it aſſumes the form exhibited by the dotted lines in the ſame figure, or as more fully ſhewn in fig. 6. plate II. Thus by having the appearance of a cornice, it will be a great ornament to the houſe.

When the curtain is put up according to this plan, which is the cheapeſt, and will anſwer in moſt caſes, the trellis, if there is any, muſt be kept at leaſt one foot under it, or about eighteen inches from the glaſs. This is recommended in order that the leaves of the trees trained on the trellis, may ſuffer no injury from the folds of the curtain when it is drawing up.

The *ſecond* mode is exactly upon the ſame principle with the practice followed by upholſterers in hanging window-blinds.

The curtain, in this caſe, is rolled upon a

ſmall round piece of wood, on one end of which is fixed a pulley, and directly under this pulley, upon the back wall, is fixed a *rack* pulley. A cord is made tight over both the pullies, and by moving this cord upwards or downwards, the curtain is either let down or rolled up. See plate IV. fig. 2.

When either of theſe curtains is placed at the top of the houſe, it will generally roll down upon the wires, (one of which is fixed under each rafter,) with its own weight. But,

If either be placed at the bottom of the front glaſs, or if the houſe is ſo flat that the weight of the curtain will not cauſe it to run down, then a cord muſt be attached to the centre of the rod of each curtain, and that cord paſſed over a pulley, placed either at the top of the houſe, or upon the top of the upright trellis or wire, as at *a*, in fig. 3. plate IV. according as it may hap-

pen, that the curtain is to be drawn down from the top, or drawn up from the bottom.

In general, however, when the curtains are fixed at top, and do not ſlide down freely, this operation may be ſufficiently accelerated by a ſmall rod, ſix or eight feet long, with a hook at one end. And,

This rod will ſerve at the ſame time to hook on the overlays of the curtains.

For the glaſs ends of houſes, a curtain ſhould be made exactly in the ſame form as the end. It may be contrived, either to be drawn up from the bottom, or to roll outwards from a pole placed upright in the angle next the back wall If of this laſt form, it ſhould have ſmall rods run through it in a perpendicular direction, to preſerve it exactly the ſize of the end. Theſe rods will prove no detriment in rolling the curtain round the pole.

In this end curtain a ſlit muſt be made immediately oppoſite the door, that the operator after he has let down and faſtened all the curtains, may be allowed to paſs out of the houſe.

The roof curtains, may either be fixed to the end curtains, by rings and hooks, or when the ends of the houſe are of maſon work no end curtain will be neceſſary. The roofing can then be faſtened to it, either by common tenter hooks, or by a narrow ſlip of cloth nailed to the wall by way of overlay.

It is almoſt needleſs to add, that when two adjoining houſes are ſeparated only by a glaſs diviſion, unleſs the one houſe be a ſtove, and the other a greenhouſe, or ſuch like, an end curtain will not be requiſite.

In the caſe of a circular houſe, or one containing

containing a number of ſides, the curtain muſt be fixed at bottom, and ſhould be made exactly in the ſhape of three or four ſaſhes. For example, in the caſe of a houſe circular at baſe, and terminating in a point at top, the curtain may cover four ſaſhes, and may be ſomething of the ſhape of fig. 3. plate III.; the narrow end of each curtain, can eaſily be drawn up to the top by a cord, and one or two pullies.

In ſuch a curtain as this, ſmall jointed rods of wood may be introduced acroſs it, as ſhewn in the figure, which will ſerve to ſtretch it to the proper width.

Rods of this kind, will generally be unneceſſary where the curtain is equally wide at both ends.

When the curtains are to come down from the top along the ſlope and to the bottom of the front glaſs, the wires upon which they ſlide in place of being fixed to the front, muſt be fixed to an upright rod of

wood

wood or iron, upon which alſo the wire trellis muſt be fixed as ſhewn plate IV. fig. 3.

When the curtains are fixed at the bottom of the upright glaſs, in any houſe, a pulley muſt be fixed oppoſite the centre of each curtain, as at *a* in fig. 1. plate IV. at the top of the ſtandards which ſupport the wire for the cords to paſs over which are uſed to draw up the curtains.

In a double roofed houſe, that is, a detached glaſs houſe ſtanding north and ſouth, with the roof on each ſide wholly of glaſs, it will generally be found beſt to fix on the curtain by this laſt mode.

In different caſes a variety of ways will require to be adopted for fitting up the inner roofing, which are not here mentioned. But it is thought that any perſon of the leaſt ingenuity, and who underſtands the hints above in connection with the plates, can

never

never be at a loſs how to proceed. Should the contrary happen, by ſending a deſcription of the caſe to the author, he will endeavour to give ſuch directions as ſhall remove all difficulty.

A number of trifling things which will occur in practice are foreſeen by the author, but as they will not prove of any conſequence he avoids mentioning them, leſt he ſhould confuſe the practical reader.

A number of curtains will doubtleſs appear to ſome a great inconvenience in a hothouſe, and the trouble of hooking on the overlays will be thought too great for general practice. But the contrary will be found true; for the curtains will generally be made ten or twelve feet broad, and thus four curtains will compoſe an inner roofing for almoſt any houſe. In Dickſons' and Shade's hothouſe one curtain covers the whole roofing, which is twenty-three feet long. Every

objection

objection of this kind therefore, appears nugatory.

If any think that the danger of the curtain taking fire is a powerful objection, they have only to wet it with *alum* water before putting it up, which as any one may easily prove by experiment, will very much hinder it from taking fire, and wholly prevent it from bursting into flames.

SECTION II.

Of the intention of the Inner Roofing.

THE use of this inner roofing is to prevent the warm air of the house from coming in contact with the glass. An object by this means completely effected.

The advantages which will result from this roofing, will be understood by every

 one,

one, when a well-known fact is adduced: *viz.* That heat passes more rapidly through glass, than through any other material. And that on the contrary, through wool or stagnated air more slowly than through any other body.

These facts are so well known, especially the former, that it is needless to enlarge upon them. Any person by standing in front of a fire or looking towards the sun, and holding before him a plate of glass, and a piece of woollen cloth alternately, may thus easily convince himself of their different capacities for conducting heat.

It is well known, that heated air always ascends, consequently in hothouses, as the greatest heat is given out from the front flue, because in general and in all good constructed houses, it communicates immediately with the fire, every particle of air, as soon as it is heated, flies up directly to the glass immediately above, and continues rising

ing along the ſaſhes, until it arrives at the top or higheſt part of the houſe; unleſs it has before this time parted with all its heat: A circumſtance which may juſtly be expected to happen, and this more eſpecially, if the joints or interſtices betwixt the overlays of the panes are left open, and not puttied up, which is generally neglected; and often moſt ſtudiouſly avoided from erroneous principles. It is no wonder that under theſe circumſtances, and during the winter ſeaſon, ſo much difficulty ſhould ariſe, both in raiſing and keeping a houſe at a given temperature: for, independent of the interſtices betwixt the panes, and the current of air, when the fire begins to decline, paſſing through and cooling the flue, &c. as mentioned before, *the conductive power of the glaſs alone* muſt carry off an inconceivable quantity of heat.

It may be obſerved here, that all gentlemen who have hothouſes, ought to cloſe up the interſtices betwixt the panes without

delay, as an immediate ſaving of fuel. That it is ſo, muſt be abundantly evident to him who will think for one moment upon the ſubject.

It is therefore needleſs to take time to point out the numerous trifling, and falſe reaſons, which have been given for oppoſite ideas; ſuch as the letting off drops of condenſed ſteam—permitting foul air to eſcape—preventing the froſt from breaking the glaſs, *&c. &c.* Nor ſhall any thing be ſaid reſpecting the ſuperiority of the other mode, but merely that it is adopted and recommended by all the principal, and moſt enlightened gardeners round London, and even by a number in Scotland; who have uniformly found no evil conſequence to reſult from the practice, (as was found at Mr Mawer's, Dalry, where, from the ſteam, it was more likely to prove unſucceſsful than in any caſe,) but on the contrary, many and great advantages in ſaving fuel, and keeping up the temperature

ture of the houſe. In moſt caſes the panes ſhould overlap one another about three ſix-teenths of an inch, and the joints betwixt each ſhould be cloſed with black or red putty.

It will appear evident to every one, who ſhall conſider the nature of the inner roof-ing adopted, that it will, in a very complete manner, prevent the air of the houſe from being cooled upon the glaſs.

To prove the advantage of this, it may be thought requiſite to relate the following

EXPERIMENT.

Though the inner roofing in Dickſons' and Shade's hothouſe, is made of canvaſs, in place of coarſe flannel, which laſt material muſt be vaſtly ſuperior, yet in very cold weather in the middle of laſt month, (February) the houſe being heated in the afternoon, to the proper degree, the inner roofing was let down, and the fire allowed to go out. Next

morning

morning the heat had only abated two or three degrees—no fire was added, but the roofing allowed to remain down all that day, (which proved to be cold and rainy,) no fire was put on that evening, and next morning at ſeven o'clock, the thermometer was within leſs than nineteen degrees of what it ſtood at when the roofing was let down forty hours before: and ſtill it was fifteen degrees above the temperature of the atmoſphere.

Had the inner roofing been of woollen ſtuff, in place of linen, ſeveral chemiſts who have examined the hothouſe, and to whom I mentioned this fact, have no doubt that it would have retained the heat for one week *.

Two

* Coarſe linen was uſed in place of coarſe flannel, from an idea that in this trial it would come cheaper; but this is hardly the caſe, and the ſuperior nature of woollen cloth, renders it decidedly preferable.

Two or three days after, the houſe was raiſed to the ſame degree of heat, about the ſame hour in the afternoon, and left without putting down the inner roofing, and without putting on any more fires, for the ſame number of hours as before. And though the weather happened to be better, than in the other experiment, the thermometer in the hothouſe, was found at the end of two nights and one day, to be only five degrees above the temperature of the open air.

Theſe facts, which were witneſſed by Meſſ. James and George Dickſon, and alſo by the gardener who had the charge of the hothouſe, Mr John Roger, a very attentive young man, will not appear ſurpriſing to thoſe, in any degree acquainted with the doctrine of heat.

SECTION III.

Of the Mode of using the Inner Roofing.

LITTLE or nothing requires to be ſaid under this head.

The *time* of uſing it in ſtoves and pineries, is during the winter and ſpring months, and in vineries and peach-houſes, during the forcing ſeaſon. During theſe periods it ought to be dropped or let down every evening, after ſun-ſet, and drawn up every morning, at or before ſun-riſe.

In ſeaſons when the curtains are unneceſſary, they may be taken out of the houſe, and preſerved dry until winter; or if it is found inconvenient to unfix them, they can be rolled up and covered with a piece of oiled canvaſs, which will preſerve them from that moiſture

moiſture which ought always to exiſt in the air of hothouſes.

When the curtains of a hothouſe are all let down, though regard muſt be had to have few interſtices, by more or leſs carefully hooking on the overlays, yet, though ſome of theſe may occur, no great loſs of heat will ariſe from them. For the whole air of the houſe being ſtagnated, as well as that betwixt the inner roofing and the glaſs, the quantity of heated air which will eſcape through theſe interſtices and come in contact with the glaſs, will be very ſmall indeed.

It may be thought by ſome, that this roofing would anſwer equally well if it was placed over the outſide of the glaſs; but this is a great miſtake; for ſuppoſing it poſſible to place it there with ſufficient exactneſs, to fix it perfectly ſecure againſt all winds, and to glaze it againſt rains, ſtill the heated air of the houſe coming in contact with the

glaſs, would give out ſo much of the heat, as that the vacuity betwixt the cloth and the glaſs in the outſide of the houſe, would be warmer than the general air in the houſe.

It is not affirmed, however, that canvaſs placed upon the outſide of glaſs roofs, as Dr Anderſon recommends, is of no uſe: On the contrary, they have always been found of conſiderable advantage. Canvaſs *covers* for hothouſes occur in two or three places in England, and at the late Mr Mawer's, Dalry, they were ſucceſsfully uſed to protect a greenhouſe. The author never heard of any hothouſes where an *inner roofing* ſuch as he has made is in uſe.

CHAP.

CHAP. VII.

OF THE AIR-PUMP, OR AIR-BELLOWS.

SECTION I.

Of the different purpofes for which Air is admitted into Hothoufes.

AIR is, or at leaft ought, to be admitted into hothoufes, for one of the three following purpofes, and frequently for all of them together.

1. For

1. For the purpose of ventilating the house; that is, carrying off all the air in the house, and afterwards passing through it in a current, until the sashes opened are shut, and then the house is left full of new or fresh air.

2. In order to mix with the air of the house, that it may prove more congenial to the plants; and,

3. In order to mix with the air of the house, merely for the purpose of lowering its temperature, when it is too warm.

These three objects being very different, it is plain, that separate modes of accomplishing them ought to be adopted. No difference however of any kind, takes place in practice; but on the contrary, whatever be the object or purpose, the sashes are opened or let down, without any farther thought or trouble.

ble. It is true, indeed, that in mild weather, or when the temperature of the houſe is very high, more ſaſhes are let down, than when it is very cold, which is ſo far good, although in fact this difference ſerves little purpoſe. But aſide from this, the conſequence of indiſcriminately letting down the ſaſhes, whatever may be the purpoſe for which air is wanted, is this, that ventilation with the air of the atmoſphere, though it ſhould be in the coldeſt winter day, is unavoidably produced, the houſe is ſuddenly deprived of all the heated air which it contained, and not only filled with that of the atmoſphere, but fanned or blown upon by a current of it, paſſing rapidly through among the plants. This muſt neceſſarily carry off much heat, chill vegetation, and bring on diſeaſes.

To remedy this evil, it ſeems requiſite to conſider the three different purpoſes for which air is admitted.

The

The common mode of opening or letting down the sashes, must undoubtedly be the most complete way of promoting ventilation with the air of the atmosphere; and in mild weather, when this can be adopted, surely nothing can equal it. Respecting this purpose, therefore, which is the first mentioned, nothing further requires to be said at present.

The two other purposes are accomplished by the same operations, and we have only to consider, which is the best mode of admitting fresh air into a hothouse, for the purpose of being mixed with that which it already contains.

Air is an elastic, or compressible body, and it is well known, that any house or vessel filled with it, in any of its ordinary states of expansion, is capable of containing double or triple the quantity of the same temperature; consequently of containing a greater proportion

still

ſtill if the air to be forced into the houſe or veſſel, is hotter than that which is contained in it, and a leſſer proportion if the air to be forced into the houſe or veſſel, is colder than that which it contains.

The great uſe to be derived from a knowledge of theſe facts in hothouſes, are evidently theſe:

1. The air of the houſe may be condenſed or cooled to any temperature, not under that of the atmoſphere, without allowing any of this heated air, now in the houſe to eſcape.

2. The operator has it in his power to enlarge, in a double degree, this medium of reſpiration (air) for the vegetables, by forcing into the houſe, once a day or ſo, double the quantity of air which the houſe uſually contains.

contains. This may be called, “ charging the houſe.”

3. It is in the power of the operator to admit a much greater quantity of freſh air, than is the caſe in ordinary hothouſes; when it often happens, that for ſeveral days together, and frequently for more than a week at a time, none of the ſaſhes can be let down or opened.

4. That this freſh air can be admitted without chilling the plants in any degree.

In proceeding to act upon theſe principles, it occurred to the author, that as the atmoſphere is often extremely cold in the winter ſeaſon, there might frequently be a degree of difficulty in performing the operations, and ſome riſk of chilling the plants, if the air was forced into the houſe immediately from without, (though it is proper to

to notice here, that there is not one tenth part of the danger, which occurs by the common mode;) it would be an advantage, if the air to be forced into the houſe were of a moderate temperature, at leaſt two or three degrees above the freezing point. Now, as moſt ſtoves have, and indeed require, a back ſhed for covering the furnace, and for containing fuel and other materials, and as the air in theſe ſheds is always temperate, it ſeems beſt calculated for being forced into the houſe.

From theſe obſervations, it is preſumed, the reader will ſee the importance of the object in view, and alſo, that it is ſo far a convenient and practicable plan. It remains only for the author to point out a machine, which may be uſed for the purpoſe of forcing additional air into a houſe already full of this fluid. The moſt economical and ſimple mode of doing this,

that occurs to him, is by uſing an air-pump, or bellows, the form and conſtruction of which ſhall be the ſubject of next ſection.

SECTION II.

Of the conſtruction of the Air-Pump and Bellows.

THE pump and bellows, though different in conſtruction, ſerve exactly the ſame purpoſe.

The pump was uſed in Dickſons' and Shade's hothouſe. It is ſimply a ſquare tube or long box of wood, open at one end and

and closed at the other. (As will easily be seen by viewing plate II. fig. 4.; where the whole machine is represented with one of the sides taken off.)

In this tube the board *a* (plate II. fig. 4.) was used as a piston or sucker. In this piston will be seen a valve, which in pressing it up (by the handle) from *b* towards *c* opens and lets fresh air into the volume of the pump. In drawing down the handle, the pressure of the air in the tube or volume of the pump, closes the valve at *a* in the piston, and forces open the valve *d*, near the other end of the pump, through which the fresh air passes into the house.

This pump was placed in the top of the roof, and in the centre of the house, (as there happened to be no back-shed to that hot-house.) A shade or cover was suspended over the upper end of it, to keep out the rain; and the under end, from which the

handle *e* proceeds, was ſuſpended in the houſe.

This pump anſwered the purpoſe of drawing in freſh air completely, but as the ſaſhes were very old, ill fitted to the rafters, and not glazed in the interſtices *, it was impoſſible to "charge" the houſe as mentioned laſt ſection, with double its uſual contents of air. It ſerves to ſhew, however, that a pump may very eaſily be conſtructed ſo as to draw in freſh air, and this is all which was intended in making it.

Since placing that pump, it has occured to the author, that in the caſe of ſtoves and pineries,

* The reader may aſk, why this operation was not done? It is anſwered, becauſe the overlays of "fragment glaſs" are ſo numerous and ſo large, (each fragment projecting an inch and often more over the next) that it would have too much darkened the houſe.

pineries, which have adjoining ſheds, the beſt way would be to have a kind of bellows ſomething of the kind repreſented by fig. 6. plate II. placed in the ſhed immediately behind the back wall of the houſe, and which could be eaſily worked by a man moving up and down the lever *a*. The air would thus proceed along the tube *b*, and enter the hothouſe immediately under the top of the roof; when deſcending it would diffuſe itſelf with the air which it already contained.

The top, underpart, and tube or nozle of this bellows, could be made of wood, and the ſides of leather. And as from the width of the tube or nozle, no great degree of ſtrength would be requiſite, and alſo little or no iron work neceſſary, the whole expence of this machine would be very trifling.

Nor will the working of theſe bellows be laborious, as the air will not be nearly ſo much

much compreſſed in paſſing through the wide wooden tube, as through the ſmall nozle of thoſe uſed in ſmithys, &c.

SECTION III.

Of the intention and mode of uſing the Bellows, or the Air-Pump.

IT is not propoſed to introduce this improvement univerſally into green-houſes, or peach-houſes, or into any glaſshouſe of the ſame nature; but principally, into pineries and ſuch plant ſtoves, as are heated by making fires during the whole winter ſeaſon.

It is thought by the author, that in houſes of this kind, two advantages will reſult

fult from the air-pump or bellows, which deſerve the ſerious attention of all thoſe who poſſeſs ſuch hothouſes, and who wiſh to ſee their exotics, green, healthy, and luxuriant.

The firſt advantage, though conſiderable, is not ſuppoſed to be the greateſt,—it is the ſaving of fuel.

The ſecond, is the advantage which will reſult to the plants, or exotics, not only by giving them more frequently freſh air, to reſpire in; but, by greatly increaſing its elaſticity, and by introducing it in ſuch a mild gradual manner, and of ſuch a moderate temperature as will not chill the plants.

For theſe beneficial purpoſes, the gardener ſhould, in ev ry day, which from its coolneſs, will not admit of the houſe being ventilated with the open air, (and this will be

be the caſe nine days out of ten, in the winter months) preſs or force in a quantity of freſh air, with the bellows, having formerly raiſed the houſe ſix or eight degrees above the medium heat, proper for the plants during the day.

It is neceſſary to repeat, that in pumping in this air, he ſhould not only have a view to bring down the temperature of the houſe to the proper medium, and give freſh air to the plants; but he ſhould alſo have an eye to "charging the houſe," that is, filling it with double the quantity of air, which it naturally contains. The advantages of which, in promoting the vegetable reſpiration, will be very evident, at once, to chemiſts and botaniſts, and it is preſumed will ſoon be ſeen by practical operators.

In many hothouſes, which have not the interſtices betwixt the glaſs puttied, this laſt uſe of the air bellows will be fruſtrated; and

even

even in the moſt exact houſes it is not ſuppoſed that they will remain " charged" in the way mentioned for many hours together; yet if we ſuppoſe them to remain more or leſs ſo, for five hours every day, this will certainly prove of ſuch advantage, as amply to compenſate for the trouble.

In connection with this plan, and for the purpoſe of ventilating the houſe with air of moderate temperature, a long leather pipe could be got, with one extremity of ſuch a ſize, as to fit the end of the bellows tube, where it enters the houſe; and with the other extremity, exactly ſimilar to the roſe of a garden watering pot.

This pipe being fixed on, and one perſon working the bellows in the ſhed, another in the hothouſe, might guide the extreme end of the pipe to any part of the houſe, or to any particular plant, which in

a more eſpecial manner required ventilation, or a ſhower of freſh air.

Regard muſt always be had that the air in the back ſhed be of a proper or moderate temperature before this operation is commenced. This can be accompliſhed, by keeping all its doors and windows cloſe, by opening the furnace door, and by ſhutting the extremity of the air-flue in the houſe; but cautions of this kind are unneceſſary to moſt gardeners; for they are generally ſpeaking, a very attentive and intelligent claſs of men. It ſhall only be further obſerved, for the ſatisfaction of ſome, that many gardeners and nurſery-men, who are in the practice of raiſing young exotics and even green-houſe plants, uſe the common bellows as a ventilator, for the purpoſe now mentioned.

CHAP.

CHAP. IV.

OF THE VENTILATOR.

SECTION I.

Of Ventilation.

VENTILATION, and *giving fresh air*, have been generally confounded together in idea, and in practice unavoidably performed at the same time. It has been already shewn, however, that there is a wide difference be-

twixt adding fresh air to the house, and putting that air which it already contains, in motion.

To accomplish this last purpose, that is, to put the heated air contained in hothouses in constant motion, is the intention of the ventilator to be recommended.

In hothouses nature has been imitated, more or less perfectly in most things. Heat is produced from the furnaces and flues. Light is admitted through the glass; rain is supplied from the syringe, or the wateringpot; dew, is raised by pouring water upon the flues, or, by steam apparatus; and fresh air is admitted at pleasure. But what makes up the want of those refreshing and genial breezes, which fan and invigorate real nature. Surely that ponderous volume of frigid air, which perhaps, for an hour or two every day, invades the sul-

try

try hothouſe, and as a rapid current ruſhes through among the tender plants, can never have the ſame ſalutary effect as a breeze of a warm temperature. As well indeed might we ſuppoſe, that in Jamaica, a breeze from Iceland would prove genial to the ſugar cane or the pine apple. It is granted, that, in the ſummer months, the open air of this country will prove more refreſhing, than any mode of ventilation which we can ſubſtitute: and green-houſe plants may perhaps be moſt advantageouſly ventilated by the free admiſſion of the open air, for nine months in the year. But in nature, there is no ſuch thing as vegetables living, for three months in the year, without enjoying the breeze, as is generally the caſe with all green-houſe plants; and it is ſtill more unnatural to think, that ſtove exotics which are deprived of this benefit for nearly nine months, can be equally vigorous, as if they enjoyed what is natural to them during that time.

By carefully comparing vegetables in the open air, with those in hothouses, or such as are in sheltered, with those in exposed situations, it will appear, that the effects of the breeze are STRENGTH: which in herbaceous vegetables, is shewn by "bushiness;" that is, a broad firm like appearance, and numerous surface roots; and in trees is shewn by bulk of timber, increase and vigour of lateral shoots, and strength of surface roots.

We see in nature, that trees and plants in the same soil and climate, and enjoying alike every other advantage, if they do not equally enjoy the breeze, if the one is in a sheltered or pent up, and the other in an open windy exposure, those of the former situation are tall, weak, unable to support themselves, and unsightly, * while those in the latter

* Unsightly only when viewed as single objects, and as specimens of the particular kind of plant or tree. For nothing

latter circumstances are healthy, robust and luxuriant. Now, this difference in effect, is totally independent of all other causes; and hence, in hothouses, supposing the natural soil, climate and situation †, exactly imitated,

thing is farther from the author's intention, than to say, that in wooded dells or forest scenery, tall slender trees, sickly branches, or decayed trunks, contrasted, and sometimes grouped with others having huge trunks and extended arms, have not a fine effect. As well might he transfer the idea to the human species, and wish not only that all mankind were of the same height and thickness, "Made in one mould, cast in one frame;" but of the same condition, age, colour, and *sex*.

† Situation is a thing by no means properly attended to in the culture of exotics. It is certainly ridiculous to think, that the uniform slope of a bark pit, of a greenhouse stage, which exposes alike to the sun, every plant which they contain, can answer equally well for plants and trees which grow on the sides of mountains, in low rich vallies, in thick woods, in shady glens, rocky crevices, and on the sides of dark caverns.

ed, yet there cannot be a doubt, and we ſee it in fact, that the want of the breeze is a material deficiency.

In the very beſt managed hothouſes, we obſerve the plants tall, ſickly, and unable to ſupport themſelves. And one proof that this is owing to a deficiency of wind or breeze, is, that we ſee the talleſt and moſt ſlender green-houſe plants, when expoſed to the open air for a few weeks in ſummer, as they uſually are, become broad and buſhy, and in general firm, and have their ſtems greatly increaſed in thickneſs, with a numerous addition to their roots:—this every gardener knows.

The ſame thing may be very evidently ſeen alſo by comparing peach houſes, which are "forced," or brought into a vegetating ſtate early in the ſpring, and thoſe which are forced later, or left nearly to the natural influence of the ſeaſon. It will occur to the recollection of every one, who has been accuſtomed

accuſtomed to obſerve them in both ſtates, that the ſhoots of the latter are always much the thickeſt and moſt luxuriant.

Moſt men confound the effects of the breeze, with the effects of light and freſh air. Light is that which produces colour in vegetables. Air is the medium in which they reſpire, and on which in a conſiderable degree they live. The motion of air, or what is called wind, by a mechanical effect upon the whole plant, produces not ſo much rapid growth, as vigorous buſhy ſhoots: and in trees by the ſame means it produces timber. Trees which are planted very thick, or in ſuch ſheltered ſituations as not to be put in motion by the wind, are uniformly ſo tall and ſlender, as to be good for no uſe in the arts. The ſame thing happens with thoſe trees and ſhrubs, which naturally attach themſelves to fixed bodies, (ſuch as walls, trunks of trees, *&c.*) as the ivy, honeyſuckle, *&c.*

and with any ſpecies of tree, when it is artificially fixed, ſuch as fruit trees trained upon walls, or eſpaliers, new planted trees fixed to poſts, &c.

Theſe cannot be put in motion by the wind, and of courſe, we always find that the diameter of their trunks and branches, makes little or no increaſe.

As the wind ſeems of ſuch conſequence to vegetation in real nature, the imitation of it in hothouſes muſt be of very conſiderable importance.

It has already been ſtated, that in favourable circumſtances, that is, in the ſummer ſeaſon, when the weather is of a temperature not greatly below that of the houſe; the ventilation produced by opening the ſaſhes, and admitting a free current of open air, is beſt.

But the intention of the ventilator is to put the heated air of the houſe in motion, ſo

ſo as to produce a breeze of warm air at pleaſure.

SECTION II.

Of the Conſtruction of the Ventilator.

UNFORTUNATELY the author has not been able to get a ventilator conſtructed in time for this publication; he ſhall here, however, give ſome ideas reſpecting the formation of one which he hopes will lead others to think on the ſubject, and perhaps to invent a better one than he has any idea of at preſent. It need not be thought from this, however, that there is any great difficulty in contriving the parts of ſuch a machine. The author is perfectly aware of a

mode which would anſwer; though he has deferred ſome weeks giving orders for conſtructing it, in the daily expectation of ſeeing Mr Andrew Meikle, of Preſtonkirk, a ſingularly ingenious mechanic, whom he believes well qualified to give him ſome uſeful hints, if not to invent one in all reſpects better. At any rate, no time ſhall be loſt in producing to the public a proper machine for the ventilation of hothouſes.

In the mean time, in order to lead others to the invention of ſuch a machine, the following thoughts are communicated.

One kind of machine which the author thinks will anſwer, is to be compoſed of two parts.

The *firſt part* is a ſmall box of machinery, about one foot ſquare, nearly upon the

the ſame principle as the patent roaſting jack.

The *ſecond part* is a fan, three feet in diameter, ſomewhat ſimilar to that of a common winnowing machine.

This is intended to be ſuſpended to the firſt part, and thus the whole machine will be finiſhed.

It is propoſed to be hung from the rafters, and to change its place once or twice a day, by this means varying the wind or breeze, in ſuch a way as that none of the exotics might be injured from too great a current, or ſuffer from a deficiency of breeze. This fan was to be ſo contrived, as that by ſome ſmall alterations it could agitate the air, more or leſs violently at pleaſure.

There

There is another machine which the author is apt to think would anſwer fully better than the former. This one is propoſed to be made upon a ſimilar principle to the *common* roaſting jack, *viz.* to act by the deſcending weight as the power. The whole machine is ſuppoſed to be contained in a box, not more than two feet broad, four or ſix feet high, and three or four feet long. It is intended to be placed upon ſmall wheels, for the conveniency of puſhing it along the paths of the hothouſe. The wind is ſuppoſed to proceed from the top of this machine, through a tube in a horizontal direction; and this tube, by a particular contrivance in the machine, is intended to turn continually round, ſo as to diffuſe the wind on every ſide.

In uſing it, its ſituation is ſuppoſed to be changed as before, once or twice a day.

It is thought that both theſe machines

would require to be wound up by a key, once every ten or twelve hours.

Other kinds have been thought of, ſome of them to move by a ſmall wind-mill, or fan, placed without the hothouſe, &c.; but it appears probable, that either or both of thoſe above mentioned, will be found to ſucceed.

SECTION III.

Of the intention and mode of uſing the Ventilator.

FROM what has been already obſerved, little more requires to be ſaid upon the ſubject. A few hints however ſhall be given, as they

may lead gardeners into a proper train of thinking on the ſubject of air in general.

As in nature, wind prevails principally during the day, and that eſpecially in the time of ſunſhine; ſo in hothouſes the uſe of the ventilator muſt be confined almoſt ſolely to the day.

1. Becauſe in the winter ſeaſon, and eſpecially in green-houſes, where no inner roofing is uſed, putting the air of the houſe in rapid motion, during the night, might have ſome little tendency to cauſe it to give out heat: And,

2. It is found, that the growth of vegetables, which takes place principally during the night, is moſt rapid when they remain at reſt, and in a moiſt atmoſphere.

It will readily occur to the gardener, that as the wind varies in the open air, blowing from different quarters, and in different degrees

grees of ſtrength, ſo ought it to be varied in the hothouſe.

This he will be enabled to accompliſh from the nature of the ventilator, which may be moved to different parts of the houſe, and ſo change the quarter or direction of the wind;—and which may be made to move ſlower or faſter, and ſo change its force.

Nature muſt alſo be imitated in reſpect to the moiſture of the air during wind. We generally find the air clear during a ſmart breeze. It is a perfect calm in foggy or thick hazy weather, when the atmoſphere is loaded with moiſture, or during the fall of rain.

Theſe and ſeveral other parts of the economy of nature which might be mentioned are not to be followed merely at ſuch times as the operator may chooſe, for this might often be counteracting nature. We

must never attempt to produce a dull thick foggy atmosphere in the hothouse in a clear sunshine day. During the winter season, on the other hand, he must withhold fresh water or dew from the exotics though it should rain hard in the open air. For this the natural climate of the different hothouse plants must be his guide, as well as the totally opposite conditions of the plants themselves:—those in the open air being at this season in a dormant state—those in the hothouse being now, and at all seasons, in a growing, and consequently much more tender condition.

But besides this general way of imitating nature, a careful gardener will consider the effects of wind not merely in producing firm bushy plants and robust timber trees, but also in carrying off fogs, and damps, which in certain situations and circumstances, tend to bring on putrefaction or decomposition and other diseases in vegetables. This will teach him

him, that when any thing of this kind happens with any plant, or in any part of the hothouſe, a more than ordinary ventilation is requiſite.

By a careful attention to the natural breeze, many other things reſpecting the imitation of wind will occur, which ſhall not be entered into at preſent.

From a proper ſtudy of nature alſo, the ſafeſt and moſt complete mode of managing heat, rain, dew, *&c.* may be learned by thoſe who ſhall carefully obſerve and reflect upon her beautiful economy. But a more full conſideration of this, as well as the general ſubject, muſt be left for the treatiſe on hothouſes.

CHAP. IX.

ON THE ADVANTAGES RESULTING FROM THESE ALTERATIONS.

HAVING now defcribed the alterations which were made upon this hothoufe, and and alfo fhortly treated of the nature of thefe alterations; in taking notice of the advantages which refult from them, it feems requifite to confider the fubject under two different heads: *viz.*

1. The advantages which have resulted in this particular case; and,

2. The advantages which will result in general.

SECTION I.

Of the advantages which have resulted from these alterations in the hothouse belonging to Mess. Dicksons and Shade.

THE peculiar and uncommon * circumstances which rendered this hothouse unfavourable

* It is very uncommon to find such a *small* hothouse with not only the *back wall*, but the *ends and front of mason work*, and even part of the slope upon which the sashes are placed covered with *deals*. See page 12.

vourable for shewing the effect of the alterations have been already noticed. The effects which have been produced however, shall be inserted without the least deviation from truth. Should the least degree of dubiety arise in the mind of the reader, he has only to examine the hothouse referred to, himself, and enquire of the particulars at Mess. James or George Dickson, or the lad who manages the house: or though he should be at such a distance as to render this difficult or inconvenient, he may employ some person in Edinburgh to visit the hothouse, and make these enquiries in his room *.

The first and most striking effect of these alterations, was the lessening of labour; for,

Formerly

* This is inserted principally for the sake of those in England who may purchase this work. The utility of the alterations are already pretty generally known in Scotland.

Formerly the fire had to be ſtirred up, and freſh fuel put on ſeveral times a day, and alſo every night at eight o'clock; and the fuel chamber being then large, there was a continual danger of raiſing the houſe to too high a temperature. This kept the lad (John Roger) perpetually employed about the hothouſe. After the alterations were made, in the ſevere weather of the end of December and the beginning of January, it was never found neceſſary to go to the fire above four times a day: *viz.* The firſt time in the morning to put on fuel, the ſecond time in about half an hour afterwards to open the valve in the furnace door, the third time in the afternoon to put on another fire, and the fourth time about half an hour afterwards to ſhut the valve, which commonly happened to be at the time of leaving off work.

At present, (end of February) it is only neceſſary to go twice a day to the fire place; for one fire ſerves during twenty four hours.

The ſecond principal effect, was the ſaving of fuel.

Formerly (in the beginning of December) one barrow load and a half, in twelve hours, and in very cold weather, more was neceſſary.

After the alterations were made (in December and January as before) a barrow load ſerved more than fifty hours: at preſent (February) a barrow load ſerves ſixty-two hours.

This appears a ſaving of more than three fourths of fuel; but when the difference of temperature of the atmoſphere, and alſo the difference of temperature produced in the houſe, are taken into account, it appears, that a ſaving of *four-fifths* of fuel is effected.

The

The next advantage is, the ſaving of time.

Formerly one lad was conſtantly employed in attending to this ſtove and the greenhouſe, and frequently he required aſſiſtance.

In the courſe of occaſionally calling to ſee the hothouſe, the author has frequently not found any perſon at hand, and Mr Dickſon has informed him, that ever ſince the alterations were made, the keeper has been every day more or leſs employed, in diſtant parts of the nurſery.

The fourth advantage was the leſſening of riſk. Before the alterations were made ſome accidents were conſtantly happening, with thoſe plants which were neareſt the furnace. Two or three yards of the flue, indeed, was always left without any plants, as they were in continual danger of being ſcorched. On the other hand, thoſe plants kept at the oppoſite end of the houſe, were

in continual danger of being too much cooled.

At preſent the houſe is equally warm throughout, as is fully known by a thermometer which is kept at each end, and in the middle. The front flue is uniformly hot throughout with pots of plants from one end to the other, which never ſuſtain the leaſt damage.

The next advantage is the ſuperior health of the plants, which is the natural effect of a more ſteady climate and more freſh air. Some may think, that ſufficient time has not elapſed to judge in this matter. And there may be ſome truth in this, as it is not yet two months ſince the alterations were made. But, ſo conſpicuous has been the ſuperiority of the vegetation during this laſt period, that it has aſtoniſhed every one who has ſeen it.

SECTION II.

On the advantages which will reſult from theſe improvements in general caſes.

To know this, it is only neceſſary to aſcertain what relation the hothouſe belonging to Meſſ. Dickſons and Shade, has to the generality of hothouſes.

It is preſumed, that none who have ſeen this hothouſe, or conſidered the deſcription given of its ſtate previouſly to making the alterations, will deny, that it was in a double degree better calculated for ſaving fuel, than hothouſes in general.

This being granted, it is plain that the ſaving of fuel muſt in general be more

than

than double what happened in this caſe. So that in all large hothouſes, * it may with perfect ſafety be aſſerted, that a ſaving of more than *nine-tenths* of fuel will be effected. And this the author will undertake to do in any hothouſe, either in England or Scotland, containing above a thouſand cubic yards of air, which is the caſe with many vineries and pine ſtoves †.

It is in a great meaſure unneceſſary to add any thing to what has already been ſaid, reſpecting

* Becauſe as the dimenſions of the houſe increaſe, the proportion of fuel ſaved, will increaſe alſo.

† The author will make one ſingle exception, which is the pine ſtove at Woodlands, Surrey, erected by Mr David Stewart. At the ſame time, though he is perfectly ſatisfied he could not ſave nine-tenths of the fuel uſed in that houſe, yet he is fully convinced, that by the addition of the inner roofing, the ſaving would be very conſiderable

respecting the other beneficial consequences which will arise. The saving of time and labour is a pecuniary advantage, which in an extensive range of hothouses, will no doubt amount to a tolerable sum yearly. But the certain benefits arising from the superior health of the plants, and the security from extremes, or risk of any kind, are greater than can well be imagined.

What are the sensations of a botanist on entering a stove, where all the plants are of

a

considerable indeed. And he is further of opinion, that by simplifying the whole, according to his plan, time and labour would be greatly lessened, not to say any thing about original expences, or the health of the plants.

That hothouse is, if I recollect, upwards of seventy feet long, and eighteen feet broad, and is wholly covered and surrounded with glass. During the winter and spring months, a vast quantity of heat must escape thro' such a large surface of glass, which the inner roofing would undoubtedly in a great degree prevent.

a pale yellow colour—where they are all drawn up into unſightly forms—where even the leaves and flowers do not aſſume their true natural ſhape, and where they all bear marks of diſeaſes?

How different muſt his feelings be on entering one, where all is health and luxuriance, where the trees or ſhrubby ſorts are each aſſuming their natural form, where the plants are tufted and buſhy, and where the natural colours and minute parts of each individual are ſtrongly marked.

Is there any difference betwixt the ſtate of a gentleman who poſſeſſes a number of vineries, peachhouſes, and pineſtoves, and yet is in continual fear of an accident which may deſtroy all the fruit,—and another gentleman who in all human probability is ſure of a good crop?

CHAP. X.

ON THE EXPENCE OF MAKING THESE ALTERATIONS.

Perhaps none of the leaſt advantages of theſe improvements is the eaſe and economy with which they may be executed; either in the caſe of altering an old, or already built hothouſe, or in erecting one wholly new.

The

The expence of altering one already built muſt depend a good deal upon the ſtate of the flue; as, in ſome caſes it may require to be wholly taken down and rebuilt, and in others the covers only taken off, the ſides heightened, and the "briggs" put in—adding the air-flue, never of greater length, than from the fire place to the other extremity of the houſe.

As formerly mentioned, one fire place to a houſe, will in all caſes be ſufficient. The furnace may be made upon a larger or ſmaller ſcale, agreeable to the proportions of the plan given in plate I. But one ſimilar to that in the plate will ſuffice for all hothouſes containing not more than a thouſand or twelve hundred cubic yards of air; and indeed for moſt hothouſes.

The price of ſuch a furnace is juſt L 2. : 10. It may be had at the Edinburgh Foundry, or at Mr Dalziel's, (Cabinet Maker,) Chapel-Street, London, on en-

quiring

quiring for LOUDON's *Improved Hothouſe Furnace*, which words are printed upon the door of the furnace. The improved aſh-pit door, made according to the figure given in plate I. and the grate, are had along the above furnace, and are included in with the price.

The alterations made upon the flues and furnace in Dickſons' and Shade's hothouſe, were executed by workmen belonging to Mr GILCHRIST, *Builder*, *Head of Leith Walk*, *Edinburgh*; whom the author can ſafely recommend to gentlemen for the execution of ſuch improvements, and for building in general. Mr G. can ſend workmen to alter furnaces and flues to any part of the country; and when gentlemen have not an intelligent mechanic in their neighbourhood, who can work from drawings, or from the plates, given at the end of theſe ſheets, this will be found the ſafeſt and moſt economical mode of procedure.

The expence of the inner roofing is the ſame both in the caſe of altering old, and making new hothouſes.

The coarſe flannel can be had from E. COLLIER & Co. *Lawn Market, oppoſite Bank-Street*, at ſixteen or eighteen pence a yard, the ſtuff being twenty-ſeven inches wide. This company have had proper directions for wetting the flannel with alum, to prevent its taking fire.

The pullies, rings, *&c.* are to be had from Mr JAMES M'LEAN, *Ironmonger, High-Street*.

Mr JAMES PHILIP, *Joiner, Broughton*, underſtands the mode of fixing up the inner roofing, and of determining the proper ſhape and dimenſions of the curtains which compoſe it, to any form of hothouſe.

Mr P. is alſo qualified to conſtruct the air-pump or bellows, and the author can recommend him for any thing elſe, either in the way of hothouſes, or in his profeſ-

ſion

fion in general, with the greateſt certainty that he will give much ſatisfaction to thoſe who may favour him with their employment.

Having noticed this much reſpecting the expence of each of theſe improvements ſeparately, ſome remarks ſhall be added reſpecting the general expence.

In the caſe of Dickſons' and Shade's hot-houſe, where, from the novelty of the plan, ſome blunders were made by the workmen; and where, from the inner roofing being erected in four different ways, before fixing on the preſent mode, the amount muſt be much more than what can generally happen. Notwithſtanding, however, the whole expence of alteration did not amount to twenty pounds.

The author conceives, that from fifteen to thirty pounds, will generally ſuffice for

altering any ordinary ſized hothouſe in Scotland. In England the additional expence will be very trifling.

The entire expence of erecting a new hothouſe, according to this plan, will not be more than half the above ſum, or perhaps eight or ten *per cent.* added to the whole expence of the houſe.

In the courſe of giving directions for executing theſe alterations upon hothouſes, the author has found Mr JAMES GOULD, Builder, Muithill, near Crieff, in Stirlingſhire, a very ingenious and intelligent perſon. Mr GOULD has for ſome time paſt been in the practice of building hothouſes in the ordinary way. He has now had ſuch directions from the author, and has given ſuch clear proofs, that he underſtands the nature of the alterations, that he can warmly recommend him to ſuch gentlemen of the ſurrounding country, as may be pleaſed to adopt any part of his plan.

The author is ſorry he cannot now refer the gentlemen in England to workmen in London and York, who could execute the improvements in the ſame way, as thoſe he has juſt recommended in Scotland. In a few weeks however, the author expects to have this in his power; and he ſhall take care, that the names and addreſs of ſuch artizans as he may fix upon, ſhall be publicly advertiſed, for the benefit of all thoſe who may wiſh to make the alterations, with no trouble and little riſk of blunders.

In the mean time, any gentleman who may wiſh to alter his hothouſe immediately, and with his own workmen, if he finds any difficulty, by ſending to the author a general ſketch, or deſcription * of the preſent

* This can be done in very few words as follows:

Length—breadth—height of front glaſs—height of back wall—two furnaces, one in each end, placed behind the back wall. The flue of one, is led round the houſe, immediately

preſent ſtate of the houſe propoſed to be altered, ſuch directions, plans, or models ſhall be ſent, as are ſuitable to the caſe, and as will be clearly underſtood. The author's mode of conſtructing the fire-place and flue, is ſo plain as to be underſtood by the ſimpleſt maſon or bricklayer.

CHAP.

immediately within the ends and front glaſs, the other makes ſeveral courſes in the back wall. Such a deſcription as this is amply ſufficient.

CHAP. XI.

ON OTHER IMPROVEMENTS WHICH MAY BE MADE IN HOTHOUSES.

SECTION I.

Of the Introduction of Improvements in Hot-houses.

THAT the conſtruction of hothouſes, is very imperfectly underſtood, among thoſe who are generally employed to erect them, will appear very evident, to any who ſhall inveſtigate the ſubject in a very ſlight manner.

Nor

Nor will this appear ſurpriſing, when we conſider the very recent date in which they have become general in gentlemens gardens.

It is preſumed, that there were few green-houſes in England before Mr EVELYN erected his Conſervatory, at ********, near London. Now the very ſame general form has uniformly been followed, till within theſe two or three years. Not indeed exactly the ſame conſtruction, for certain iron "pipes" which Mr E. ingeniouſly, but rather unſucceſsfully introduced for the purpoſe of ſupplying heated air, have been rejected; and this evidently without that enquiry into their intended uſe, which was due to every ſcheme deviſed by that great man.

The firſt ſtove erected in Scotland, was that which belonged to the late Mr JAMES JUSTICE *, at Crighton, near Edinburgh, and

* A great enthuſiaſt in gardening, particularly in the culture of flowers.

and if we obſerve the plan of this hothouſe, as given in Juſtice's Britiſh Gardener, we ſhall obſerve little or no difference between it, and the moſt improved conſtruction of pine ſtoves at the preſent day.

With reſpect to books on hothouſes, there has never yet been publiſhed any thing in the way of enquiry into the principles of their conſtruction and general management.

Mr Evelyn in deſcribing his conſervatory, gives two or three hints reſpecting the properties and management of air, which are deſerving of attention. But in the ſeveral books of deſigns, which have been publiſhed, and are to be had at Mr Taylor's architectural library, Holborn, London, not a word is added reſpecting the principles, or even the properties of the deſigns recommended. Indeed theſe deſigns are impracticable, and ſuch as could not anſwer the purpoſes of horticulture. The natural conſe-

quence which has ever followed hothouſes, deſigned by mere houſe architects.

The plans given and recommended by Mr ABERCROMBIE, Mr SPEECHLY, and ſeveral others, anſwer better; but, they contain no deviation from general practice; nor do we find that theſe men have ever thought or written upon the principles of their conſtruction.

The ſame obſervations will apply to the deſigns recently publiſhed, by Mr WALTER NICOL in his Forcing Gardener *. It is proper to remark, however, that theſe deſigns, tho' exactly upon the principle with thoſe mentioned above, are perhaps, upon the whole, better adapted for the purpoſes of forcing. At any rate they are preferable to any thing that has hitherto appeared in this country. The

* By Creech, Edinburgh 1802.

The public are greatly indebted to Dr ANDERSON, for the many ingenious hints contained in the account of his patent houſe, * and this ſingle volume is certainly of more importance, than all the other deſigns or books upon the ſubject which have yet appeared. But though in ſome of the warmeſt counties in England, the Doctor's hothouſe may, perhaps ſucceed for a year or two after the houſe is erected, it is the humble opinion of the author, that it will never come into general uſe.

In different parts of the iſland, there are, and have long been, peculiarities in the conſtruction of ſome hothouſes, which, had they been underſtood and attended to by planners, would, long ere now, have made a material difference in the conſtruction of hothouſes.

* Publiſhed by R. Cumming, Holborn, 1803.

At Abercairnie, near Crieff, in Stirlingſhire, heated air introduced by the furnaces and flues, has long been uſed in a peach-houſe. And though the conſtruction by which this is effected, is extremely imperfect *, yet the end is anſwered in a conſiderable degree, and a tolerable ſaving of fuel is produced.

The author has been told by a gentleman (Mr L**, Hammerſmith) in whom, he can place the utmoſt confidence, that heated air was introduced into a hothouſe in the neighbourhood of Mancheſter, near forty years ago; and as it is probable there may be ſome other caſes in England, which has not yet come under the author's eye, it is likely,

* Imperfect, but not ſo completely erroneous, as at Archerfield, Eaſt Lothian, where heated air was lately brought from the furnaces in a vacuity immediately under the ſmoke flue.

likely, (however ſtrange it may ſeem,) that the practice may be traced as far back as Mr EVELYN's time. This beneficial improvement, having eſcaped the attention of planners, who muſt have ſeen or heard of ſome of the inſtances mentioned, but who evidently have not underſtood its nature, would have been loſt to the public, had not Mr STEWART, gardener to J. J. ANGIERSTEEN Eſq, Blackheath, Surrey, brought it boldly forward to public notice, in his patent hot-houſe. Mr S. deſerves much credit for bringing the thing into public notice, and it is to be hoped, he will find ſuch a demand for his kind of patent hothouſes * as amply to recompenſe his ingenuity.

The author by adverting to thoſe hot-houſes formerly mentioned, conceived his plan

* Which are very different from Dr ANDERSON's. Fuel being in them conſidered as neceſſary. See ſome deſcription of Mr STEWART's pine ſtove, chap. 8. ſection 2.

plan of collecting and introducing heated air in hothouses: and by thinking on the subject, and by considering the nature of heat, he also formed the idea of an inner roofing, and of the air-pump or bellows. These he has carried into execution, in the hothouse in Broughton park nursery, at so trifling an expence, and with such uncommon success, as will induce him, when an opportunity presents itself, to execute several other improvements. Some of these he shall mention in the remaining part of this chapter, partly with the view that some may have it in their power to try them, and partly to draw the attention of others to devise still greater improvements.

The author would at the same time beg leave, to caution gentlemen against too suddenly making alterations upon any plan in the way of improving upon it. During the time that the operation

tions treated of in theſe pages were going on in DICKSON's and SHADE's nurſery, it afforded much amuſement to the author, to hear the conjectures and remarks made by ſome gardeners and planners about the intention of the different parts; and after they were finiſhed, it was ſtill more curious to hear, what they propoſed as additional improvements; moſt of which were ſo completely oppoſite to the nature of the plan, that had they been executed, more heat would have been loſt, than is by the common mode of conſtruction. Such would have been the effect of carrying the air flue a certain length around the ſmoke flue, and afterwards below it only. Or, as was propoſed by another, of carrying it a certain length around the ſmoke flue, and then making it occupy the narrow vacuity betwixt it and the front wall. Several other improvements were propoſed, but it is ſufficient to mention theſe as ſpecimens, in

the

order to guard gentlemen against an over-rashness in adopting opinions.

When a proprietor is about to make improvements, either upon his grounds, garden, or mansion, he would do well to distinguish betwixt sound argument and mere assertion, even though they should be the assertions of professional men. For when two men are attending to the same subject, that is a proprietor and his designer, why should not the arguments which convince the one, reach conviction to the other also. These arguments should, at least be candidly stated by designers, and attentively listened to by gentlemen before any thing is done. And were this the case, a practice would take place in rural improvement, very different from that which prevails at present.

SECTION II.

Of additional improvements in the modes of heating Hothouſes.

Might not many hothouſes, in certain ſituations be heated without having flues within the houſe?

Firſt, Suppoſe, as is very frequently the caſe, that the journeymen gardeners are lodged in an apartment in the ſheds, placed behind the range of hothouſes; let the ſmoke of their fire, be conducted in a flue throughout a cloſe compartment in the ſhed, containing perhaps, from fifty to five hundred

cubic yards of air. From this compartment, which, for the ſake of diſtinction, we ſhall call the air chamber, let pipes be led to as many of the hothouſes, as it may be ſuppoſed capable of ſupplying with heated air. Suppoſe that two pine ſtoves are to be heated by this mode. Two pipes muſt be conducted from the top of the air chamber, to each of the ſtoves, and having their extremities placed at ſome diſtance from one another, near the bottom of the upright front glaſs. Let other two proceed from the bottom of the back wall, or the loweſtpart of the houſe, wherever it may be, to the loweſt part of the air chamber. The conſequence of this arrangement will be, that, as the air in the air chamber becomes heated, it expands, and the hot air aſcends, and is forced through the upper pipe into the hothouſes; while to ſupply the waſte of air in the air chamber, and alſo, to make room for the heated air to enter the houſe, a currrent of

cooler air will naturally be forced into the chamber through the lower pipes. The heat thus added to the ſtoves, could be regulated by cloſing one or both the pipes occaſionally. And if at any time, it was found requiſite, ſuddenly to raiſe the temperature of the heat of the ſtoves, a pair of bellows with a nozle, which may be joined to any of the upper pipes, may be uſed; which will thus force the heated air into the houſe with rapidity.

Secondly, But as air is of ſuch a ſtationary nature, the above mode could only anſwer in ſome caſes, and therefore the following mode appears more generally uſeful.

In the air chamber, let an air flue be conducted along the top and ſides of the ſmoke flue, and let the pipes for drawing off the cool air from the houſe, enter at one extremity; and the other pipes which are to conduct the

the hot air to the houses, be led from the other extremity. In this way, it is certain, such a circulation would be produced, as could not fail to answer the proposed end. The air added or taken from the pine stoves, could easily be regulated as before. In this case, there would be no need for bellows. The only disadvantage attending it, would be the loss of some heat, which would escape from the air flue, but this would not be great.

This scheme, the author is of opinion, would in many cases prove highly advantageous. The flue would be at all times hot and ready to deliver heated air, to at least two or three ordinary sized hothouses, constructed with an inner roofing.

Thirdly, In some cases, it may be inconvenient to have an air chamber or flue from the fire place, which happens to be near hothouses. Here a vacuity, formed by plates of

of iron can be made round the fire itself, and sometimes round the whole, or part of the chimney, and from the top and to the bottom of this vacuity, pipes may be conducted from the hothouse as before. If this was carefully done, it is probable, that the command of heated air, would be greater than in the former case.

Fourthly, This last plan might be adopted in the case of fire-places at considerable distance from the garden.

The pipes, except where they joined the vacuity, might be of wood. One square pipe or tube, could be placed within another, and so fixed by props as not to come in contact with its sides. This sort of double pipe might be made to serve at the same time for conducting the cool air of the hothouse to the vacuity, and round the fire-place and chimney. This vacuity formed around the pipe of hot air, would greatly

greatly prevent the air in the inner pipe from being cooled. This double pipe could be led from the fire-place to the hothouſe in a wall if ſuch happened to be at hand, or, in the centre of a ſmall maſs of maſon work which could be built under ground. In building *in* this tube, it would be a great advantage to wrap it round with ſtraw, an inch or more thick; and in two or three places to drive in nails, ſo as that their points might juſt enter the wood, and their heads be even with the outer ſurface of the ſtraw.

Theſe ſtraw covered pipes being built in a wall, or in the maſs of maſon work under ground, in a few years the ſtraw would rot and leave the double pipes in the centre of a vacuity ſupported by nails, as ſhewn in plate VI. figure 3. by which means very little of the heat conveyed in the air of the ſmall centre pipe could eſcape.

The caſes, where this plan could be adopted, are very numerous; indeed we can

hardly

hardly imagine a hothouſe in ſuch a ſolitary ſituation, as would, if proper arrangements were made, prevent the plan from having its full effect.

If the gardener's houſe was not at hand, perhaps ſome cottage, or waſh houſe, dairy, &c. might not be far diſtant, or even the kitchen of the manſion, may frequently happen to be within a quarter of a mile of the garden, than which there could not be a better ſource for obtaining heat at all times. And thus, without the trouble of carrying the vacuity for heating the air up the chimney, a double plate carried round the fire-place, would in general, prove ſufficient for any two hothouſes; and were this vacuity continued up the ſides of the chimney which would make no difference in the external appearance, nor produce any inconvenience in the kitchen, it is preſumed, that hothouſes, though placed a quarter of a mile diſtant from the kitchen, might be heated by the

fires

fires commonly made in ſuch, with perfect eaſe.

The author would not have advanced ſo much on this head, had he not tried the effect of kitchen fires, in heating lobbies, and rooms at conſiderable diſtance. But of this, the public ſhall hear more in a ſhort time.

Fifthly. A vacuity and conducting pipes might perhaps be made around dung hil s with advantage. The effect of M'PHAIL's cucumber frame, and of ſome hothouſes heated by dung, ſtrongly juſtifies the ſuppoſition.

Sixthly. Hothouſes might frequently be erected with advantage upon the tops of other houſes as ſtables, cowhouſes, or even cottages, or other ſorts of dwelling-houſes. Various are the modes by which this may be done.

When a mere greenhouſe or conſervatory is wanted, nothing more is neceſſary than

than in place of the ordinary roofing of ſlate, tile, or thatch, to ſubſtitute a roofing of glaſs; having the ſaſhes conſtructed ſimilar to thoſe in hothouſes, for the purpoſe of giving air. This kind of green-houſe will anſwer perfectly upon any kind of houſe, cottage, or ſtable, &c. and the heat of the apartment below will be communicated to the greenhouſe above, through the ceiling of the lower apartment. In cottages, or ſome houſes, this ceiling may be made of any material, and ſmall holes about an inch in diameter made in it in different places; but in ſtables &c. the ceiling may be made of large tyles, or thin pavement and no apertures left.

When it is required to make a vinery or ſtove above a houſe or cottage, the chimney, or ſhaft of the fires in the apartments below may be carried around it as flues, which will give an amply ſupply of heat at all times. But as this will not be required

in the ſummer ſeaſon, a damper muſt be fixed in the flue, at its junction with the chimney, and by ſhutting or opening this damper, the ſmoke can be prevented from entering the flue. Another damper would alſo require to be fixed in the chimney, a little above this junction, ſo as to force, or rather direct, the ſmoke into the flue.

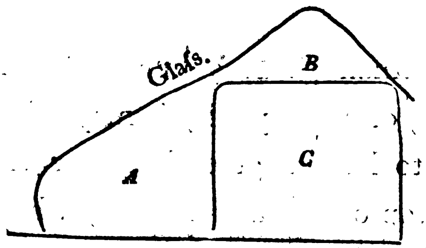
The air vacuity around the fire-place may alſo be uſed as formerly recommended.

In both theſe caſes the principal thing to be attended to, is ſo to contrive the ſituation of the houſe, cottage, or ſtable, as that the entrance and acceſs to the green-houſe, pinery or ſtove, may be eaſy and elegant.

When theſe, or ſuch houſes, can be placed along the outſide of the north garden wall, this will eaſily be accompliſhed. A range of cottages may be placed along the outſide

of

of the wall, (the wall may ferve for one fide of thefe buildings.) Glafs may be placed in front of the wall, and with the fame flope be continued to the top of the cottage roof, as under.



The lower glafs houfe *A*, may be heated by the air from the fire-place, and the upper one *B*, by the fmoke in the flue, and by the heat of the under apartment *C*.

The hothoufe *A* may be made a pinery; and vines may be trained under each rafter, and at the top of this houfe enter the bottom of the upper one, where they may be trained upon a trellis forming it into a vinery.

It is probable, however, that the beſt way, when a row of cottages can be commanded, is to place the glaſs upon the wall only, forming one ſuch houſe as *A* which could be eaſily heated by the air from the fires, &c.

But in ſmall gardens in towns, or in mere plots, or court yards, it may often be agreeable to have a green-houſe or vinery upon the top of a houſe or ſtable, where to place glaſs upon its ſides would ſerve no purpoſe. The roof alone muſt be covered.

It may be remarked here, that there can hardly be a caſe ſuppoſed, either in a town or village, where the hothouſe could not be warmed by part of the air collected around either the kitchen fire-place of the houſe to which it belonged, or round ſome other adjoining fire-places. This the author conſiders of conſiderable importance to

many

many in London, who have, or who may intend to build hothouſes.

SECTION III.

Of heating hothouſes by Steam, and of Steaming in general.

PERHAPS the operation of ſteaming hothouſes, by boilers was no where carried on more extenſively than at Dalry, by the late Mr MAWER, a well known Planner and Nurſeryman; as the author was for a conſiderable time his draughtſman and general aſſiſtant, he had every opportunity of obſerving the whole proceſs, from the erection of the boilers in 1794, to the death of Mr MAWER in 1798.

It

It is not the intention of this ſection to treat fully on the ſubject, but merely to ſtate the general reſult; becauſe many perſons more fond of ſpeculation than well grounded in ſcience, think that ſteam may be uſed with immenſe advantage in hot-houſes.

At Dalry we had five very large boilers, which ſteamed two pineries, two peach-houſes, and two vineries; we tried boilers of a variety of forms, and various modes of ſupplying them with water. We alſo tried copper, *tinned*, and *white iron* pipes for conducting the ſteam to the houſe. We tried alſo to heat the houſe by filling it with vapour from the pipes, and alſo by making the vapour paſs through it, and thus heating it by the heat emitted from the pipe alone. In the pineries, we had alſo ſteam pipes in the barkbed, the vapour of which we could either allow to be ſpent among the bark, or to diſperſe itſelf through the

air of the houſe—we tried alſo a great variety of other ways, and made a great number of experiments both as to its effects and as to the expence attending it, (ſome of which experiments were ſent to the Board of Agriculture,) But the reſult of the whole, although never confeſſed nor made public, was, that "*Steaming by boilers is not only unneceſſary, but an immenſe expence.*"

Steaming by boilers is totally unneceſſary; becauſe as every gardener knows, a hothouſe can be ſufficiently filled with ſteam at all times, by pouring water upon the flues or even upon the floor.

If it is unneceſſary, it is evident the whole expence of the apparatus, which is conſiderable, and the trouble and riſk, which are enormous, muſt be all thrown away. The author therefore is clearly of opinion, that it is the moſt abſurd thing imaginable, to erect boilers for ſupplying hothouſes with ſteam.

ſteam. If any kind of implement or utenſil were even to become neceſſary a carron plate, with edges one inch in height of any covenient ſize, may be placed upon the hotteſt part of the flue, and filled with water. A vaſe or any utenſil, cloſe ſhut at top, and with a very ſmall hole about half an inch from its bottom, may be placed upon it, which will thus keep the plate conſtantly covered with water, and at the ſame time allow none to run over. A plate of this kind containing ſix ſuperficial feet, and placed upon the hotteſt part of the flue, will produce abundance of ſteam, for a very large houſe—and when ſteam was not wanted, it would be in no danger of being rent by the heat, as boilers continually are.

Steaming of hothouſes, whether accompliſhed by boilers, carron plates, or what is certainly better, mere watering in the houſe, is of great importance when properly done; and

and equally dangerous when done at an improper season and in a wrong manner. It must be considered, that when the house is sufficiently filled with steam, the greater part of the heated air is driven out—and that as soon as the steam condenses, which it does in a very rapid manner, the space which it occupied is replaced with cool air from without.

Steaming therefore in winter, in cold weather, and particularly in the night time, must be very dangerous; for it is evidently next to impossible to keep up the house to a proper temperature in these cases.

In moist weather, and in the winter season, steaming is also very dangerous for bringing on the "damp" as every gardener knows. At all times it has a tendency to dirty the glass and rot the wooden work. But on the other hand it is most excellently adapted for destroying and preventing insects; particularly the redspider; and like the dew in

the open air, it is admirably calculated to promote vegetation in every ſtage from the bud to the ſwelling of the fruits or ſeeds. The air in hothouſes ſhould never be more charged with ſteam, than the open air, appears to be charged with dew in the evenings. Nature affords the beſt examples and inſtructions for ſteaming.

To procure a ſlow conſtant ſteam, may be thought by ſome a matter of difficulty, as it is not obtained by pouring water upon the flues, which may be very proper ſometimes, but by watering the more cool parts of the houſe, as the floor, paſſages, *&c.* or by giving the whole plants and houſe a gentle ſhower with the feringe.

No rules can be given equal to what every one may learn by attentively obſerving the dews and evening ſhowers in the ſpring and ſummer months. And indeed a careful attention to the ſtate of vegetables in foggy, clear, blowy, and rainy weather, are of great

great importance in directing our practice in the hothouse; every operation performed in which should be in imitation of the more perfect economy of nature.

It is easy to conceive, that if a hothouse were infected with insects, they might be eradicated by steaming it two or three times with some liquid, the steam of which would prove deleterious; or by placing in it retorts charged with some deleterious matter, to be heated by lamps, which would soon fill the air with a noxious gas that would destroy all the insects without the least degree of trouble in shifting the plants. This scheme would probably save a vast deal of labour and expence.

It is needless to observe that a degree of caution would be necessary in entering the hothouse after this operation. The sashes ought to be let down, or pushed up, and the doors thrown open to admit a free current of air before any person ventured in; and

 even

even afterwards a brisk fire should be lighted and the house well watered in order that a strong steam might carry off every remaining noxious effluviæ.

At Dalry we never had occasion to try this experiment, for excepting a few of the scaly insects (coccus) we never had any other. The coccus is completely eradicated with soap suds and sulphur.

Constant steaming rots the blossoms of strawberries, injures succulents, as Cactus, Aloe, *&c.* and destroys the aroma or flavour of fruits, when too much used at, or near, their ripe state.

A mode of using steam will be detailed in next section, which the author conceives will be very advantageous.

SECT.

SECTION IV.

Of a new plan for growing Pine Apples.

OF all the different kinds of hothouſes which are made in this country, pine-ſtoves are the moſt expenſive, both to erect at firſt and manage afterwards.

There are three things which have rendered them more expenſive, when firſt made, *viz.*

1. More furnaces, and a greater length, or more windings of flue are required than in other hothouſes, in order to produce the higher

higher degree of heat requisite for maturing the pine apple.

2. The expence of the pit for the bark in which the plants are "plunged" or inserted.

3. The expence of paved passages around the house.

The great expence which is incurred in the future management of the pine-stoves is owing to the following causes:

1. Attendance being necessary throughout the whole year, and constant fires being requisite during three-fourths of it. These two things may be greatly lessened, but can never be fully removed.

2. The expence of the renewal of the bark in the pit; and,

3. The

3. The continual expence attending the operation of renewals, and of turning over the bark when it cools, so as to regenerate fermentation, and thus produce a fresh heat.

The original and after expence of the bark, and a considerable part of the expence of attendance in general, the author hopes will be effected by the following plan, which will answer either for altering stoves already built, or for erecting new stoves, or pine pits.

1. The general form of the hothouse is of no consequence as to this scheme. But whatever that may be, an inner roofing, sliders are supposed to be used, and the furnace built as formerly directed.

2. Convey the flue throughout the house, as is represented in plate V. fig. 1. where *a* represents

represents the furnace, above which is the shaft or chimney.

The air-flue must be continued upon the top of the flue from the furnace to *b*, where it must terminate in an opening, which may be closed or shut by a "dove-tail" iron cover, or register valve to be afterwards described: a similar opening must be made at the other end of the house, as at *c*, of the same size, and with a cover fitted to it in the same manner.

The smoke-flue need not be made above *two bricks breadth* in depth, but of considerable width, say two feet. Tyle covers of a suitable size, must be had, or stone covers will answer better where they can be economically procured.

The flue being thus finished, a large air-chamber of the breadth and length of the house, is to be formed around and above it, by flooring the whole house with pavement, or large tiles placed upon supports, as shewn

in

in fig. 2. plate VI. By this figure it will alſo appear, that the firſt turn of the flue, upon which alone the air-flue is made, has its foundation ſo much lower than the reſt.

The houſe being wholly paved, a paſſage muſt next be marked off, through the middle of the houſe, above the openings which communicate with the air-flue, as ſhewn in fig. 2. plate V. This paſſage forms the houſe into two beds or pits for the plants, *viz.* *A* and *B*. In each of theſe above the pavement may be laid broken bricks, ſtones, or (in England) flints, four or ſix inches diameter, for ſix or eight inches depth, above theſe may be laid two inches of rough gravel,—over that one inch of coarſe ſand, and afterwards the ſoil for the plants. See theſe ſhewn in plate VI. fig 2.

The intention of theſe rough ſtones is to preſerve an air-vacuity betwixt the earth in

which the plants are placed, and the heated pavement. And the great advantage of having it formed in this way, is, that these stones and gravel, &c. will preserve the heat a much longer time, and completely prevent any danger of over-heating the roots of the pines. This will be guarded against with absolute certainty, by the current of air which will enter by holes made at equal distances, in the passage wall, as at *f f f*, plate VI. fig. 1. and being rarified among these stones will pass off into the house by the upright tubes *g g g*, &c. in fig. 2. plate V.

These holes and tubes have each covers or stoppers, neatly fitted to them, the use of which will appear afterwards. Water may also be poured in at these holes, in the passage parapet, or by the tubes *g g*, which will raise a moist natural heat, (so congenial to vegetation,) and will pass out of the tubes as steam. In this way a moist heat,

equally

equally ſalutary with that of bark, leaves, or dung, may be had, without the leaſt riſk of producing thoſe dangerous extremes to which theſe fermentable materials are liable; and without any of the trouble of renewing them, or of ſhifting the plants in order to ſtir up or augment the " *bark bed.*"

When the water is poured into the ruble ſtone vacuity under the plants, by ſhutting all the holes in the parapet, and alſo putting on the covers of the tubes, the ſteam generated would aſcend through the gravel and ſand into the plant-bed: And there it will be condenſed among the earth and the roots of the plants, which would prove very beneficial. Even when no fire is uſed by pouring in water in this way, (although the precaution of ſhutting the hole and tubes were not taken,) it would prove of great advantage to the plants, by producing a moiſt " natural" heat in the ſoil.

The tubes could be left open at pleaſure, and then the water poured in would fill the houſe with ſteam. Or when the houſe was too warm they could be ſhut, and then the heat would be retained, &c. So that inde-pendent of the moiſt and uniform heat produced in the bed by thoſe tubes, and by the vacuity, the temperature of the air of the houſe could alſo be raiſed or lowered at pleaſure.

There are alſo openings in the paſſage which communicate with the large chamber that ſurround all the flues, by opening which the whole heated air can be admitted into the houſe at once *

Any perſon capable of reflecting upon the

* It is almoſt needleſs to add, that by pouring in water in theſe openings, the air given out from this large chamber will alſo be moiſt.

the ſubject, will perceive, that from this large air-chamber, and the large maſs of maſon work, which will be continually hot, three conſequences will follow of the utmoſt importance: *viz.*

1. During the ſeaſon when fires are uſed the temperature of the houſe can be raiſed at pleaſure.

2. There can be no danger of overheating the houſe.

3. During the ſeaſon fires are uſed, ſteam could be produced in the greateſt abundance, by pouring water into the air-flue by the openings *k k* into the paſſage.

But ſhould it be found that theſe advantages will be produced, and the author has little doubt but they will, there are others which will alſo reſult from the ſcheme.

The

The plants which are intended to come into fruit, in these hothouses may be planted at proper distances among the earth, without being potted. And as for some time after they were planted, the spaces betwixt them would be very wide, pine plants in pots might be plunged there, until the plants intended to remain and produce fruit, grew so large as to cover the surface. Those in pots might then be removed to hotbeds or pits, where they would remain until they were required to replace any which might have fruited, &c.

This method of placing plants in pots among these planted in the bed, will be understood by the following diagram, where o represents the plants in pots, x those planted in the bed.

o x o x o x o x o x o x o x
x o x o x o x o x o x o x o
o x o x o x o x o x o x o x
x o x o x o x o x o x o x o
o x o x o x o x o x o x o x

About ſix or eight months before the plants were intended to come into fruit, thoſe in pots ſhould be removed, and then the others would remain thus,

x x x x x x
x x x x x x x
x x x x x x
x x x x x x x
x x x x x x

Some gardeners will produce as an objection to this mode of " plunging out the plants" in the bed, that " hereby they are prevented from coming into fruit ſo ſoon as when grown in pots." But the experience of ſeveral gardeners in England proves, that this is owing to the plants being put into an

improper

improper ſoil—that is, a ſoil too rich, and deficient in ſand. But even in a rich ſoil, ſuch as one compoſed wholly of rotted leaves, many gardeners know that if when fruit is ſpeedily deſired, the plants have their roots cut round ſix inches from the ſtem or centre of the plant, they never fail to "ſhew" fruit ſoon after.

Another advantage, and one of no ſmall conſequence for the health and beauty of the plants, and the flavour and magnitude of the fruit is, that by uſing earth, in place of bark, the plants may eaſily be placed on a ſlope correſponding to that of the glaſs, which will bring them all equally near the light.

By having a paſſage in the centre of the hothouſe only, in place of one around it, as ſhewn fig. 2. plate V. and fig. 2. plate VI. nearly *one third* more pines can be grown in an ordinary ſized houſe.

It

This plan for a pine-ſtove, the author conceives will coſt much leſs when erected, and prove afterwards more economical than any in preſent uſe. While at the ſame time he thinks it will produce a larger quantity of better flavoured fruit.

Beſides theſe advantages there are ſeveral others which the author thinks would attend this mode; but theſe, and ſome minute particulars reſpecting it, he ſhall omit at preſent, until he finds an opportunity of putting the plan in practice. He cannot however, avoid giving it as his opinion, that if pits or hotbeds were uniformly conſtructed according to this mode, though in ſome caſes it would perhaps be a little more expenſive at firſt, yet it would ſucceed much better, produce healthier plants, larger and better flavoured fruit,—do away all riſk and danger from extremes of heat or cold, and ſave much labour, time, and expence.

SECTION V.

Of an improved pit for growing young Pines, Cucumbers, Melons, &c. *or for forcing fruits or flowers.*

BY preſerving in view the principles o the pine-ſtove, recommended in the preceding Section, the author preſumes that a pit for growing young pines, raiſing cucumbers, melons, for blowing early flowers, or for any ſuch purpoſe, may be made, as ſuperior to thoſe in common uſe, as it is ſuppoſed the pine-ſtove will be.

A

A plan and alſo ſections of this kind of pit are given in plate VII. which are rendered clear by the letter preſs explanations.

It is ſuppoſed a hundred feet long, and is divided into four compartments, all of which are heated by one furnace. Theſe diviſions can be kept at the ſame, or of different degrees of heat, by means of the heated air collected around and near the furnace.

It will be ſeen in fig. 1. plate VII. that two flues proceed from the ſame furnace, and enter immediately into two different diviſions of the pit.

The heated air collected around the furnace and flues, in theſe two diviſions may be allowed to eſcape into any one of the four apartments of the pit.

This is accompliſhed by keeping all the different regiſters ſhut, except the one in the diviſion in which the air is to be admitted: or, the heated air may be permit-

ted to enter into two, three, or the whole of the divisions at pleasure, by properly opening and shutting the valves.

The intention of the two flues which proceed from the furnace, is in case it should seem requisite to heat only one half of the pit at a time, or to produce an early and late crop of melons and cucumbers.

When one half of the pit only is to be heated, one of the flues must be stopped by bricks or clay, and the air registers in the cold half of the pit kept constantly shut, in order that the whole of the heated air generated, may be conveyed to the heated divisions.

When one half of the pit is to be raised much hotter than the other, as may often happen in the case of forcing different plants, or growing different exotics, one half the throat of the flue which leads to the half to be least heated, can be built up,

which

which will permit only one half the quantity of ſmoke and heat to enter it.

By means of the air-flue and the two ſmoke-flues, the four diviſions of the pit may very eaſily be kept of four different temperatures. For example, ſuppoſe that three-fourths of the ſmoke enters one flue, and only one-fourth the other, (from its being half cloſed ;) it follows, that the heat of two diviſions of the pit, muſt be as three, and that of the other two as one; and the ſame may be ſaid of the heated air in the flues. Now, ſuppoſe all the heated air generated by three-fourths of the ſmoke allowed to paſs into one of the hotteſt apartments, and all the heated air generated by one-fourth of the ſmoke, let off into one of the coldeſt apartments; it follows, that there will be four different temperatures in the pit. The firſt in the

diagram below *A*, ſuppoſed equal to one; *B*, will be equal to two; *C* to three, and *D* to four.

A 1	B 2	C 3	D 4
Aſparagus.	Roſes and Straw-berries.	Pine Ap-ples.	Cucumbers and Melons.

And thus in a pit ſo conſtructed will one furnace ſerve for forcing aſparagus, ſtraw-berries, roſes, pine apples, cucumbers, and melons as in the above diagram.

It is almoſt needleſs to mention here, what muſt be underſtood from the im-proved pine-ſtove, and from the plate, that each of theſe apartments is ſupplied with ſteam and heated air from the tubes. The holes for pouring in the water which is

to

to produce this ſteam, are ſhewn in fig. 2. Theſe holes are alſo intended occaſionally to admit air, to be rarified in the vacuity, but this muſt be done with caution, particularly in the winter months.

The tubes which ſerve for occaſionally admitting all the heated air contained in the lower chamber, are alſo ſeen in the plate.

The inner roofing propoſed for this kind of pit, is ſomewhat different from that uſed in large hothouſes. It is ſimply a roll of woolen cloth, as ſhewn fig. 7. plate VII. It is the breadth of three ſaſhes, and has a ſmall round rod of wood, fixed to each end, on either of which it can be rolled up. Wires as before, are fixed under each rafter for it to ſlide down upon. In the evening, when the inner roofing is to be uſed, a ſaſh is opened at one end, and a curtain introduced at the top of the pit, and laid upon the wires, and allowed to roll down, the operator holding the rod of one end

in

in his hand. When it has rolled out, he fixes the two ends of the rod in the iron hooks ſhewn by *a*, plate VII. fig. 6. he then introduces another curtain, and lets it down in ſame way. Thus with almoſt no trouble the whole may be made quite cloſe and tight. In the morning when this roofing is to be removed, the operator goes to the top and rolls up the curtains, one by one. He may then either take them out of the pit, and lay them in a dry ſhed, or in the winter ſeaſon, allow them to remain in the pit, as ſhewn by the dotted lines in fig. 6.

No overlay is required in theſe curtains, as the one can eaſily be made to project over the other. But two or three ſmall rods ſhould be fixed to each curtain, parallel to the end rods, which when they are rolled down, will preſerve them ſtretched out to the proper breadth.

It is the opinion of the author, that this plan of a pit is perfectly practicable, and he thinks the dvantages which it willproduce

in

in ſaving much time, labour, and expence afterwards, and in maturing crops of fruits or early flowers, are of much importance to gentlemen who indulge in theſe things. He is certain, that in many places of Scotland, by ſubſtituting pits of this kind, in place of long ranges of ugly dung hotbeds, the manure ſaved, if judiciouſly formed into compoſt heaps with peat, (as was long ago practiſed in Ayrſhire, and recently with great ſucceſs by LORD MEADOWBANK,) would be no imconſiderable profit to ſeveral proprietors, and by poducing more corn or butcher meat, of ſome advantage to the nation in general *.

SECT.

* For this purpoſe no gentleman in the neighbourhood of peat or moſs, ought to allow a ſingle cartfull of ſtable dung to be made into hotbeds. Nor indeed to be uſed in any way whatever, until it has changed or decompoſed a proper proportion of peat into manure. Gardeners may no doubt cry out for manure to the garden, but let them be told, that they can have this in equal abundance from the "*Meadowbank middens.*" They will have no occaſion to

SECTION VI.

Of an improved Peach-houſe.

WHAT has been ſubmitted in the two preceding ſections, though founded upon facts, may be conſidered as in a certain degree, theoretical. The plan to be recommended here, as an improved mode of growing peaches, is founded upon experience.

Every one knows that theſe trees are always "trained" upon a wall or trellis. The practice

complain on other accounts, as he will ſoon find his labour greatly leſſened by the kind of pits recommended, which he may make of any dimenſions, or raiſe to any temperature, to ſuit his purpoſe.

practice of training trees upon walls or eſpaliers, in the open air, originated from a deficiency in our climate. By training and faſtening the branches, the trees were preſerved from violent winds, and when this was done on walls, the additional heat produced by the reflection of the ſun was conſiderable. Some may be diſpoſed to add as another advantage of training, that the branches and fruit are thereby uniformly expoſed to the ſun. But this is not true, for only one ſide of the tree and fruit is fully expoſed; and, as this is completely unnatural to all trees *, it cannot be any benefit, but undoubtedly an injury.

It is certain, that in ſituations much expoſed to the wind, fruit is never ſo much ſhaken from eſpaliers, as from ſtand-

* Ivy, and one or two others excepted; and here it takes place only with the ſteam and leaves, the fruit being ſmall and in a *corymbus*, is expoſed alike on all ſides.

ard fruit trees: And it is equally certain, that peaches, nectarines, and apricots, cannot be matured in the open air of our island, unless trained upon walls. But it may be seen by any one who shall attend to the subject, and it can be proven from known facts in the vegetable economy, that in gardens tolerably sheltered, all fruit trees, at least apples, pears, and cherries, always produce the greatest quantity, and the best flavoured fruit, when left to assume their natural shape; with no more pruning than what is necessary to admit the sun and air among their branches. It must follow from this fact, as well as from what has been already alluded to,—the general economy * of vegetables,—that peaches, nectarines, and other tender sorts of fruit trees, could we plant them in a suitable climate, must prosper

per

* See the chapter on ventilation and giving air, and also Mr KNIGHT's late experiments recorded in the Phil. Transactions.

per much better when left to aſſume their natural ſhape, than when bound or faſtened.

One principal intention of placing vegetables in glaſs houſes is, that they may enjoy their natural climate, and why they are not alſo allowed to enjoy their natural freedom, can only be accounted for, by adverting to the deficiency of obſervation and reflection, in thoſe men who generally have the direction of gentlemen in matters of this kind *.

When

* It is tireſome to obſerve the errors that men fall into, and the immenſe labour, difficulty and uncertainty, with which they think or reaſon upon any ſubject, when they do not advert to nature. I think I may venture to ſay, that there are few arts or ſciences, and but few topics in each of them, but what we have a precedent for, in nature. And could men at their firſt outſet in any ſubject, look boldly through the opinions, or works, of thoſe who have gone before them, to nature herſelf, there can be no doubt that their ideas would be wonderfully enlarged, and that they would receive more light upon the ſubject by a few hours reflection, than thoſe who may have devoted a whole life time to the trial of experiments, which, though ſome of them might agree, with—yet the greater part were perhaps at variance with her laws.

When the late Mr JOHN MAWER of Dalry, deſigned his own hothouſes, it happened from a particular circumſtance in forming them into a range, that two large ſpaces were left betwixt the pine-ſtoves and the narrow peach-houſes. As theſe ſpaces were more eaſily connected with the peach-houſes than with the pine-ſtoves, it was thought they could be moſt economically occupied as part of the former. But as there was no back wall in theſe ſpaces, there was no way of growing the trees except as ſtandards. Standard peaches therefore were planted two trees in each ſpace which grew rapidly. To compare them minutely with the trees planted againſt the walls, in the other part of the houſe is needleſs. It ſhall only be obſerved, that at Mr MAWER's death, both the wall and ſtandard trees had been ſix years planted; the former were pruned and otherwiſe treated in the uſual mode, and bore ordinary crops of fruit, ſome years, few,

in

in others a confiderable quantity. The latter never had one twig cut from them, and every year bore a double proportion of more beautiful, larger fized, and better flavoured fruit, than thofe of the others.

A double crop of fruit, and much lefs expence of management (for training and pruning are tedious and expenfive operations) are certainly advantages which deferve ferious attention, whatever may be the circumftances which produce the overplus. But when the caufe affigned for this fact agrees fo well with what happens in ftandard and efpalier apples, and with the general economy of nature, it ought (and it cannot fail,) to convince every one capable of reflecting on the fubject, of the great fuperiority of the plan recommended: And confequently, that peaches, nectarines, &c. when grown under glafs, fhould not be trained either upon the walls, trellis, or efpaliers; but fhould be planted as ftandards, and left

to

to aſſume their natural ſhape and modes of growth.

Suppoſing this granted, ſome hints ſhall now be ſubjoined reſpecting the form of a houſe moſt proper for this purpoſe.

The firſt thing requiſite is, that the houſe ſhall be glaſs on all ſides, in order to admit light to every ſide of the trees.

That this may be beſt effected it follows, that it ſhould be made of an oblong form, and placed ſouth and north; and that the trees ſhould be planted along the middle of the houſe.

The next thing is, that the ſide or upright glaſſes ſhould be made as high as poſſible, in order that the trees may not be cramped or compreſſed.

This naturally reminds us, that the houſe ſhould be of a conſiderable height, at leaſt twelve or fourteen feet.

In order that no ground in the houſe be loſt, it ſeems preferable to plant dwarf-trees

that

that they may fill the houſe with branches, regularly from the ground to the roof.

No vines ſhould be planted againſt the rafters in this houſe, but they may be planted near the columns, and trained around them to their tops, where they may be left in a great meaſure to themſelves, and in the progreſs of their growth they will hang down obliquely, and ſtretch acroſs among the branches of the trees, forming curious and diverſified feſtoons of grapes and peaches, and producing more fruit than if neatly trained in ſtraight lines, upon a wall or trellis.

I cannot avoid mentioning here, my utter diſapprobation of the common mode of training vines, by fixing all their ſhoots in ſtraight lines; it is juſt as unnatural as it would be, if a gardener were to inſert a plant of ivy in a park

and endeavour to train it up as a ſingle tree. A ſingle glance at a vine plant, not to mention what we know of its habits when in a wild ſtate, will ſhew that nature never intended it to grow in a ſtraight direction. Every gentleman in Scotland, (for in England it is better known,) ought to cauſe his vines be trained crooked, or in a ſerpentine direction. This will make them ſpring at, and ſend out ſhoots, from every eye, and produce double crops of fruit every year. See *Forſyth on fruit trees.*

The plan for a peach houſe given in plate VIII. may be placed either with one end againſt a wall, or made a detached houſe (as in the plates,) in any part of a garden, or orchard. In this laſt caſe the furnace can be concealed under ground, and the ſhaft or chimney either carried up in a ſmall plate iron column, as in the plate,

or

or in a flue under ground, to the garden wall, or ſome concealed ſpot.

It may be worth while to remark, that when the flue is carried under ground, a vacuity muſt be formed around it, in order to prevent the bad effects of the damp or moiſture of the ground, from retarding the draught of the fire.

But though this particular form be recommended as the beſt conſtruction of a peach-houſe upon the principle contended for, yet houſes may be made much in the ordinary way, and the trees grown as ſtandards with an effect, it is preſumed (and indeed it is certain, as the peach-houſes at Dalry, where the ſtandards ſucceeded ſo well, were placed againſt a wall, and were alſo greatly ſhaded by the pine-ſtoves)—much ſuperior to the common mode of training a trellis.

The principal thing to be attended to in

this

this caſe is, to make the upright glaſs of conſiderable height, and the houſe not of great breadth.

A ſection of ſuch a houſe is given in plate IX. fig. 4.; vines are ſhewn trained upon a trellis placed againſt the back wall. A plan agreeable to this ſection, is eaſily contrived.

It may farther be obſerved, that ſtandard peaches may be grown in the ordinary kind of peach-houſes; or, indeed in any kind of hothouſe, by planting dwarfs, and as they grow up directing their branches in ſuch a way as they may not come much in contact with the glaſs. A thing more or leſs neceſſary in every conſtruction of a houſe for growing ſtandards, and which even requires to be done when trees are trained upon a trellis. A ſection of a houſe altered in this way is given plate IX. fig. 5.

SECT.

SECTION VI.

Of architectural decorations in hothouses.

In Architecture which, is intended to pleaſe the appearance of ſolidity and ſtrength are eſſentially requiſite. For this purpoſe it is a rule with architects, that openings be made above one another, and that every ſolid appear of ſufficient magnitude to ſupport the ſuperincumbent parts of the edifice. When openings are very numerous in one part of a building, and when another part adjoining ſeen at the ſame time, contains very few, it never

never fails to diſpleaſe. If the heavy part be uppermoſt, it appears to cruſh down that which is below; and, if the light and open part be uppermoſt, it appears diſproportionate to the reſt and trifling. Hence it is that maſon work can ſeldom be allowed to appear in the elevation of hothouſes; and thus old faſhioned greenhouſes, with ſtone columns, and a ſtone parapet above, generally, if not always, look heavy and diſpleaſing. Old greenhouſes with wooden columns and a ſlated roof, as well as modern glaſs-houſes, when the back wall againſt which they are built appears above them, look exceedingly ill. Cuſtom cannot reconcile us to this effect, tho' we are certain that no part of the wall bears any weight upon the glaſs. Even the ſtone coping when ſeen projecting over the glaſs, is exceedingly ugly. The modern mode of carrying up ſummerhouſes above hothouſes, as at Preſtonhall in Scotland, and

Heythrope

Heythrope, in England, in the opinion of the author at leaſt, have a very bad effect in ſcenery; beſides their incongruity when conſidered as overlooking the kitchen gar-den, which certainly like the kitchen itſelf is not an object intended for beauty. Maſon work in hothouſes diſpleaſes alſo in another point of view. Every one knows that their uſe is to grow vegetables, and none are ſo ignorant, as not to be aware, that plenty of light is eſſentially requiſite to produce fruit and flowers in perfection. Slate roofs then, thick ſtone columns, or dead walls, tend to exclude this fluid, and of courſe to fruſtrate the end in view.

Thus it appears, that in hothouſes, every thing in the elevation which has a heavy appearance, or tends to exclude the light, in ſome degree fruſtrates their utility, diſ-pleaſes the eye, and conſequently ought to be avoided.

For this purpose a good general rule may be,

1. To let no mason work be seen above the level of any part of the glass.

2. That the whole of the roof be glass; and,

3. That the wooden workmanship be made as light as possible.

And it may be observed, that this effect will be most perfect, when they are totally unconnected with any wall or stone building, but merely raised upon a level surface, built on all sides with glass, and roofed with the same material.

Circular columns, are inadmissible in the sides of hothouses; because they are unsuitable for sashes or panes to slide in, and because they throw more shadow than square ones. In all cases square pillars are best; where they require to be broad, they may be paint-

ed

ed green and covered with virgin's bower. Pasiflora or ſome ſuch ſhrub. When ſo narrow as not properly to admit of being covered with foliage, they may be painted the general colour of the wood work, which in all caſes ought to be a yellowiſh white or cream colour. In hothouſes erected merely for the purpoſe of utility, ſuch as vineries, peach-houſes, &c. the workmanſhip ſhould be plain, neat, and ſubſtantial; in thoſe deſigned for ornamental productions, ſuch as the greenhouſe, exotic ſtove, &c. elegance ſhould be added. The mouldings, &c. may be more numerous, and delicate, and every thing elſe in a correſpondency. The colour of the walls and flues ſhould be brown or of oaker yellow, the ſtage in the greenhouſe, and all the inſide work, except the roof and ſides, will have the beſt effect in one of theſe colours, particularly under brown. The rafters, pillars, and walls, in the inſide of ornamental hothouſes ſhould

always be covered with exotics. Many beautiful ſpecies of which are ſuitable for this purpoſe, ſuch as the Paſiflora, Morinda, Jaſmine, &c. Externally, they ſhould be painted of a cream colour, or yellowiſh white.

CONCLUSION.

Three objects have been kept in view in the foregoing pages:

The *firſt* of them was to give ſuch a deſcription of the alterations made upon Dicksons' and Shade's hothouſe, as would enable practical men, to make the ſame improvements,

provements upon others, or to build new hothouses agreeable to this plan.

The *second* object was to give a short treatise upon the nature and effects of these improvements, that ingenious gentlemen might understand the principles upon which they operate: And,

The *third* object was to suggest improvements of another kind in hothouses,—and those chiefly in the construction of pineries, peach-houses, and pits.

With respect to the first object the author observes with much pleasure, that he has every reason to believe, the improvements which he has made, will become general. In regard to the second and last, he will be happy if any thing which he has written shall contribute to enlarge the ideas of hothouse builders and gardeners; and hence either

ther directly or indirectly, to the advancement of the art, and the benefit of gentlemen, who indulge in this amusing and rational luxury.

EXPLANATION

OF THE

PLATES.

EXPLANATION

OF THE

PLATES.

PLATE I.

Fig. 1.

Loudon's improved Hothouse Furnace.

a The opening in each fide, which communicates with the air vacuity.
b The inner furnace door---9 inches fquare,
c Valve in the outer furnace door for admitting cool air to be heated upon the

the inner furnace door, and in the vacuity around the fuel-chamber, &c.

d Handle, which opens, shuts, and fastens, both doors at once.

e e "Nobbs," which are for the purpose of fixing the furnace more securely in mason work *.

FIG.

* There is a beautiful variety through all nature, which a person of a contemplative mind is ever admiring. This variety in the animal as well as in the vegetable kingdom, is mightily supported by contrasts or oppositions. The meadow walk at Edinburgh, is shadowed by a row of stately beeches, and though those trees when planted at regular distances are all very much of a shape, yet each of these, are so different from one another, that a person might spend in a most agreeable manner, a very long time in observing their several forms and varied hues of green. In walking along the promenade and examining each tree, how much is the beauty of the whole heightened, when near one end of the row, there suddenly appears an old shattered trunk with its branches greatly scathed, and

FIG. II.

Ash-pit door to Loudon's Hothouse Furnace.

a The valve.

b The handle.

c Part of the frame on which the door is hinged, turned inwards and hooked at the extremities in order that it may be fixed more securely in the mason work.

FIG.

and curtailed.——————I have already said that during the time the alterations were making upon Dicksons and Shade's hothouse, I had been much amused with variety of opinions,—by hearing the workmen relate what some planners and others, purposed as improvements. When the alterations were proven to be of importance, and had in some measure attracted public attention, the author was again amused by reports of what some would call a worse kind. But what a fund of entertainement did he partake of, when after these varied efforts to *skath* or *blast*

Fig. III.

Ground plan of the Fuel-chamber, Air-vacuity, and part of the Flue.

a The fuel-chamber.

b Furnace door.

c Receſs for preſerving *live feul.*

d d Bottom of ſmoke-flue.

b b Vacuity around the fuel-chamber, and part of the flue communicating alſo with the furnace door.

Fig.

blaſt, a "landſcape gardener" who happened to be getting ſome common furnaces made, pleaſed with the one recommended and ſold at the foundry, quietly copied (as the Edinburgh Foundry people told me,) one part of it after another, until at laſt he produced a furnace almoſt an exact copy of that in the plate. This perſon affords like the decaying trunk, a ſtrong contraſt to the reſt of his profeſſion—and like it muſt ſtrikingly affect the attentive obſerver, or moral painter.

FIG. IV.

Vertical section of the fuel-chamber, supposing it finished, and cut through in the direction a....b, fig. 3.

a The ash-pit.

b Bars of the furnace grate.

c Upright rise of the flue above the recess, for preserving the live coals, see *m*...*n*, fig. 5.

d Throat of the smoke-flue.

e Arch over the fuel-chamber.

f Air vacuity.

g A brick seen projecting down in order to support the upper arch.

h Mass of bricks around the whole, being part of the wall of the hothouse, as may be seen by the dotted line *a b*, in fig. 3.

FIG. V.

Longitudinal ſection of the furnace, and part of the ſmoke-flue, ſuppoſing them finiſhed and cut down in the direction of e....f, fig. 3.

a Space betwixt the outer and inner furnace doors, in which the hole that communicates with the air vacuity is ſeen.

b Fuel-chamber.

c Receſs for live-fuel.

d Grate.

e Aſh-pit.

f f Handles of furnace and aſh-pit door.

i and *g* Vacuity for heated air under the "receſs" and part of the ſmoke-flue.

h h Smoke-flue, five bricks breadth in depth.

z Air-vacuity above the fuel-chamber.

k Contraction of this vacuity, immediately before the air-flue commences.

l l The air-flue.

o o Sole

o o Sole of the furnace and flue.

p p Supports of the flue.

q Bottom of the ſmoke-flue

r Covers of ditto, which ſerve alſo for the bottom of the air-flue.

ſ Covers of the air-flue.

FIG. VI.

Section of the ſmoke-flue and air-chamber ſurrounding it, ſuppoſing them finiſhed and cut through in the direction ſhewn by the dotted line c....d, in figures 3. *and* 5.

a The ſmoke-flue.

b The air vacuity and flue.

The ſcale ſhews the form and the dimenſions of the bricks ſuppoſed to be uſed in building the furnace, flues, &c.

1 Is the end of a common brick.

2 The edge of ditto.

3 The face or breadth of ditto.

4 The

4 The end of a common flooring or pavement tyle.

5 The furface of ditto.

6 The fide and the front of a large tyle cover, fuppofed made on purpofe for covering that part of the air-flue, which from being continued on each fide of the fmoke-flue, is broader than the other parts. Where the air-flue is continued above the fmoke-flue only, common tyles, as No. 5. will anfwer.

In Scotland pavement will generally be had as conveniently as tyle of this fize. In England the tyle covers, will be moft economical.

PLATE

Fig. 1.

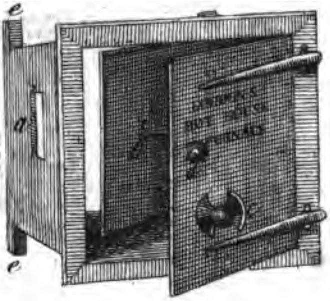


Fig. 3.

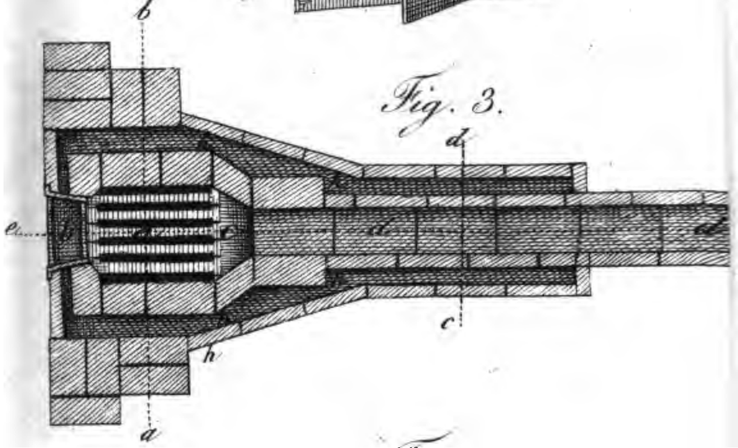
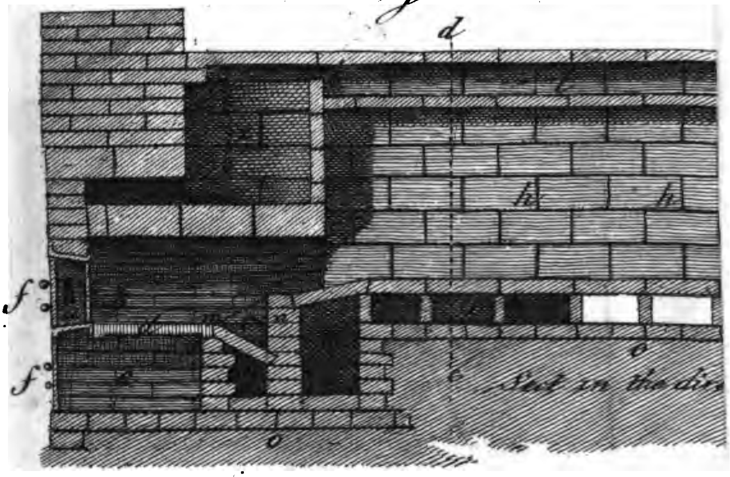


Fig. 5.



J. Loudon Del.

PLATE II.

FIG. I.

Longitudinal ſection of the ſmoke and air flue as erected in Dickſons' and Shade's hothouſe ſhewing principally,

A A THE "briggs" or partitions in the ſmoke-flue.

B B The air-flue.

a Sole of the flue, being bricks laid flat.

b Supports of the flues (being bricks ſet on edge.)

c Sole of the flue being ordinary tyle covers.

d End of the ſmoke-flue being bricks on edge.

e Cover of the ſmoke-flue.

f Intended to ſhew heated air coming out of the air-flue. Here, however it would be

be better to fix one of the regiſters deſcribed in plate VI, as they would anſwer better for regulating the quantity of heated air admitted into the houſe.

FIG. II.

Section of the ſmoke-flue, and air-flue, ſuppoſing them cut acroſs at the dotted line i....k in fig. 3. plate I.

a The ſole.

b The ſupports.

c The ſmoke-flue.

d The air-flue.

FIG. III.

A ſection intended to ſhew the manner in which the briggs, or partitions, are formed in wide flues; and alſo how the heated air may be conducted in an earthen pipe in certain circumſtances. See pages 34 and 35.

a Section of the earthen pipe.

b Briggs

b Brigg or partition.

c Hole under it for the ſmoke to paſs through.

d Supports of the flue.

The covers and ſole of this flue are ſuppoſed to be made of large brick or ſtone pavement.

FIG. IV.

View of the air pump uſed in Dickſons and Shade's hothouſe.

a The piſton or ſucker, with its valve for drawing in cool air.

d The valve for allowing this air to enter the houſe.

f One of the ſides of the pump taken off, in order to ſhew its internal ſtructure.

e Handle of the pump.

FIG 5.

Longitudinal ſection of a broad ſhallow flue, ſhewing the beſt way of conſtructing the partitions.

a The brigg or partition which comes down to the level of the ſole of the flue.

b A receſs, made in order that the ſmoke may paſs under the partition.

c Air-flue.

d Pipes for conducting the heated air.

e Supports of the whole.

f f Smoke-flue.

FIG. 6.

Section or end of part of a hothouſe ſuppoſed to be altered according to the new plan, and having the air bellows.

a The handle of the bellows.

b The tube which leads the air to the houſe.

c The

c The termination of this tube where the air enters the houſe.

d Section of the inner roofing.

i The wire upon which the curtains which compoſe it roll down.

f The cord by which they are faſtened.

g The uſual mode of coping the walls of hothouſes.

PLATE

PLATE III.

FIG. I.

A view of one whole curtain, and part of a ſecond mounted with rings, &c. *according to the firſt mode of fixing up the inner roofing.*

a a The overlay.

b b Rings fixed to the edge of the overlay.

c c Hooks on which the rings are put when the curtains are let down in order to keep them cloſe.

d d Cord

d d Cord for pulling up and letting down the curtains.

e e Rod fixed to the lower end of the curtain.

f f End of the curtain to be fixed to the top of the hothouſe.

FIG. II.

Section or end view of a hothouſe ſhewing the appearance which this firſt kind of curtain will have when let down.

a The curtain the rings of which are ſeen.

b The cord which ſerves for drawing it up.

c The wire upon which it is ſupported.

d The hook upon which the cord of the curtain is fixed.

e Dotted lines ſhewing the appearance which the curtain will have when tucked up, as more clearly ſhewn fig. 6. plate III.

f f Back wall coped with ſtone in the uſual manner.

Fig. III.

Form of curtain ſuitable for compoſing an inner roofing to a circular houſe.

a b c The three pieces which compoſe the curtain.

d d The overlay with the rings, &c. as before.

e e e Jointed rods which are for the purpoſe of ſtretching the curtain to the proper breadth when it is drawn up.

f Ring at the top of curtain, to which is fixed the cord uſed for drawing it up. This kind of curtain being ſuppoſed to be placed at the bottom of the upright glaſs.

g The rings and cord for drawing down and tucking up the curtain, which paſs through a hole at the bottom, and not at the top, as in fig. 1.

FIG.

FIG. 4.

A ſection ſhewing the appearance this laſt curtain will have when tucked or folded up.

a The bottom of the front glaſs or front-wall.

b The curtain folded as it remains upon the front parapet at the bottom of the upright glaſs until it is drawn up.

c The wire upon which it is drawn up.

e A pully, over which is put the cord uſed to draw up and let down the curtain.

f The cord which is paſſed over the pully.

PLATE IV.

Fig. 1.

A view of part of a houſe with the inner roofing put up, according to the mode of fixing the curtains upon rollers.

a a Coping of the wall.
b b Rafters of the houſe.
c Lower curtain which is firſt rolled down.
d d Upper curtains which are afterwards let down, and which overlay the others—without the aſſiſtance of rings, hooks, &c. as in the firſt kind.
e End curtain which is rolled outwards, &c.
f Rack pullies for letting down or rolling up the curtains—fixed only at one end of each wall.

g Level

Fig. II.

Shews the manner in which the cord is paſſed round the pully on the end of the roller, and the rack-pully upon the wall.

This kind of curtain ought to roll down from above as ſhewn at *e*, fig. 3; and not from below, as in this figure.

If from the deſcription in Chap. VI. Sect. 1. and theſe two figures, this mode of fixing the inner roofing ſhould appear intricate, which it may do to ſome who are not acquainted with theſe things, the author can only refer to the model, which none can be at a loſs to underſtand.

Fig. III.

Section of a vinery ſuppoſed to be built according to the propoſed plan.---A vinery of this kind is at preſent conſtructing at —— Smith's, Eſq: Leith Walk, under the author's direction.

A The front flue, made broad and ſhallow, ſuited to this ſituation.

 b The

B The back flue deep and narrow agreeable to its ſituation.

c Partition ſeen in this flue.

d Dotted lines ſhewing where the air bellows is placed.

e End of the curtain.

f Rack pully.

g End of the rod of wood which is attached to the curtain.

h Wire upon which it ſlides down.

i Trellis on which the vines are trained.

k k Upright rods of wood or iron, each being one inch broad, and $\frac{1}{4}$ of an inch thick, to ſupport the wire trellis, and the wire upon which the curtain ſlides; theſe rods are fixed to a ſtone or board at bottom, and joined together at the top. They are alſo fixed to the rafters at the top, but this only betwixt each curtain, for otherways theſe fixtures would interrupt the rolling down of the curtain. In this way they only interrupt the hooking on the overlay which

can be prevented by making a ſlit in it, oppoſite to the fixture.

l A ſmall piece of iron under each rafter which ſerves to fix the trellis and wires to the back wall.

m Upright rafter, placed upon the front parapet.

n The ſloping rafters.

o Mode of coping by lead and ſlate, by which are joined the roofs of the hot-houſe and backſhed, approven of by the author, as more ornamental and durable.

p Water ſpout continued along the front of the houſe.

q Dotted lines in the back wall, ſhewing how the chimney is carried up.

PLATE V.

THIS PLATE AND PLATE VI. CONTAINS PLANS AND SECTIONS OF A PINE STOVE UPON A NEW PRINCIPLE.

Fig. 1.

The ground or foundation plan of the walls and flues.

A Back wall.
B Front wall.
C End walls.
D Flues.
E Back ſhed.
a Furnace.
c Termination of the ſide vacuity.
b Termination of the top vacuity or air-flue.

Fig.

FIG. II.

Surface plan ſuppoſing the houſe cut over by the line a....b, in plate VI. fig. 2.

A and *B* Two pine pits.

a...b Paſſage through the centre of the houſe.

D A vine introduced from behind intended to cover the back wall. Vines may alſo be introduced at the two front corners to run up the ſaſhes.

g g Air or ſteam tubes.

K K Regiſters or valves for admitting heated air either from the air-flue, or from the large vacuity under the pit, or for pouring in water to cover the ſurface of the whole pit, or to cover the ſurface of the air-flue, and thus to produce either ſteam or moiſt heat in abundance.

f The ſituation of holes made in the parapets for pouring in water to the ruble ſtone vacuity under the bed of earth, ſee B. fig. 2. plate VI.

PLATE VI.

Fig. I.

Longitudinal Section of Figures 1 *and* 2 *in Plate V. according to the line a....b, fig.* 2.

a Doors at the ends.

b Smoke-flue.

c Supports of ditto.

d Supports of paſſage-pavement.

e The communication of the air-flue with the regiſters, *K K*, in fig. 2. plate V.

f Holes

f Holes in the wall of the pit for pouring in water, &c.

g End walls.

h h Ground level.

Fig. 11.

Tranſverſe Section of fig. 2. plate V. upon a larger ſcale.

A Paſſage through the houſe.

B Ruble ſtone vacuity.

C Earth in which the plants are inſerted, either in pots or otherwiſe.

D Air and ſteam tubes.

E Curtain of the inner roofing.

F Rack-pully for ditto. Here alſo may be fixed the hooks for faſtening the cords uſed to pull up or let down the glaſs ſaſhes.

F Back ſhed.

G A ſpace which may be made an excellent Muſhrom-bed.

H Vacuities around the flues.

I Air-flue.

K Smoke-flue.

L A row of bricks to preſerve water over the whole ſurface of this chamber, when it is poured in for the purpoſe of creating moiſt heat, &c.

M Dotted lines ſhewing the direction of the ſhaft or chimney.

N Dotted line ſhewing the manner in which the damper is placed.

O The author's mode of coping and roofing hothouſes and backſheds.

P Spout for collecting water from the roof.

Q Ground level.

FIG. III.

Is a ſection of a ſmall maſs of maſon work, containing a circular hole in the centre

centre, which hole contains two pipes or tubes, one within another. The inner one is for conducting hot air, and the outer cool air, and the ſpace without the outer one is to preſerve air ſtagnated, in order that as little heat as poſſible may be loſt. See a full explanation, Chap. XI. Sect. 2. page 150.

Fig. iv.

Is a perſpective view of the carron regiſter or valve for regulating the heated air from the flue, which may be had at the Edinburgh Foundry, Edinburgh, or at Mr Dalziel's, Cabinet-Maker, Chapel-Street, Bedford-Row, London, along with the furnace, aſh-pit door, and damper.

PLATE VII.

PLAN AND SECTIONS OF A PIT UPON A NEW CONSTRUCTION.

FIG. I.

Ground Plan.

a Front wall.
b Back wall.
c Flues.
d Supports of the pavement, above which is placed the *ruble ſtone, and then the earth*, &c.
e Furnace.

f Steps

f Steps to the excavation in which the furnace is contained.

g g Chimneys.

h h Dotted lines ſhewing the ſituation of the ſmoke-flue.

FIG. II.

Horizontal Section, or ſurface plan of this pit, ſuppoſing it erected and cut over by the line a....b, fig. 4.

A B C D The four diviſions which may be kept of four different temperatures.

e e Air and ſteam tubes.

f Air regiſters.

g Covers of the excavation for the fuel and furnace, &c. partly cut over.

FIG.

Fig. III.

Elevation of the Back wall.

A Furnace and aſh-pit doors.

B B Chimneys.

C Walk round the back wall of the pit.

D Holes for pouring in water, or admitting freſh air to the ruble ſtone vacuity.

Fig. IV.

Tranſverſe Section of this Pit.

A Earth in which the plants are placed.

B Partition in the ſmoke-flue.

C Pit for fuel, *&c.*

D Supports, made in this particular form, in order to admit the free circulation of the heated air, and to ſave bricks in building.

Fig.

Fig. v.

Longitudinal Section.

A....*B* Range of ſaſhes.

C Spaces betwixt the ſupports of the pave-ment.

D D Flues.

E Centre diviſion wall.

F F Tubes which admit air and ſteam from the ruble ſtone vacuity.

G A tube which admits air and ſteam from the large vacuity under the ruble ſtone, which ſurrounds the flues.

Fig. vi.

Shews the Mode of fixing the wires for the inner roofing.

Fig.

FIG. VII.

A Curtain ſuitable for a Pit of this Conſtruction.

a a The two poles, one of which are placed at each end.

b.b The ſmall rods for ſtretching out the curtain when let down.

PLATE

PLATE VIII.

GROUND AND SURFACE PLAN FOR A PEACH-HOUSE, UPON A NEW CONSTRUCTION.

FIG. 1.

Ground Plan.

a a Foundation of the ſurrounding walls.
b b Flues.
c c Termination of the ſide vacuity.
d d Partitions in the ſmoke-flue.
e e Supports for the columns, which columns are better ſeen in fig. 2.

f f Termination

f f Termination of the ſmoke-flue, where it aſcends the centre column as a ſhaft or chimney.

g Furnace, and pit for fuel, &c.

Fig. II.

Surface Plan, or Horizontal Section.

a Columns which ſupport the roof.

b The column which ſerves as a ſhaft or chimney.

c c Top of the flue which ſerves as a paſſage around the houſe.

d Doors.

e Section of the upright rafters, placed on the front walls.

f Small holes to admit the heat from the vacuity betwixt the front flue and wall.

g Dotts, ſhewing the end of the wires upon which the inner roofing ſlides down.

h h Cover of the furnace, fuel, pit, &c.

PLATE

PLATE IX.

FIG. I.

Longitudinal Section of the improved peach-house, which may be easily understood by comparing it with the line a....b, in figures 1 *and* 2, *Plate VIII.*

FIG. II.

Transverse Section of the improved peach-house, upon a larger scale than the ground plan. See c....d, of figures 1 *and* 2, *Plate VIII.*

a A part of the column which ſerves both for a chimney and prop to the roof.

b The damper in this column formed in a manner ſuitable to the internal aperture, which is circular. It is contrived ſo as to be turned round by the handle ſeen at *b;* in place of drawing it out in the uſual manner.

c The furnace, around which will be ſeen the air vacuities, the ſmoke-flue, and aſh-pit, &c.

d Furnace and fuel-pit, which are covered from the view by the cover, which is ſuppoſed to be level with the ſurface of the ground, and painted green.

e Supports of the flue, made of conſiderable depth, in order to allow the roots of the trees to ſpread in every direction, which they could not do, if a maſs of maſon work were introduced below the flues and front wall.

f View

f View of one of thoſe ſupports.

g Surrounding walls, built no higher than the ſurface of the ground. The line acroſs the wall at *g*, ſhews the depth of theſe ſupports.

Some may think it adviſeable to have the level of the ground, within the peach-houſe, raiſed as high as that of the open air, in order that the roots may more eaſily penetrate from the one to the other; but this makes no material difference.

h Upright glaſs raiſed upon thoſe walls.

Fig. III.

Section of both the Plan and Elevation of the improved peach-houſe, ſuppoſing it finiſhed and the trees and vines full grown.

In this ſection it will be obſerved that the inner roofing is made according to the mode

 ſhewn

ſhewn in plate III. which will have the beſt effect in a double roofed houſe.

FIG. IV. AND V.

Are Sections of the approved mode of planting the peaches, and alſo of introducing vines in peach-houſes. See pages 196—7.

FIG. VI.

Is a view of one of the flue, or front wall ſupports, ſuppoſed to be made of a ſingle ſtone.

FIG. VII.

A view of one of theſe ſupports formed of bricks, in ſuch a way as that the roots of the trees may paſs through it in every direction.

N. B. The explanations of the models are ſeparately printed, and are had along with them, and included in their price.

POSTSCRIPT.

THIS work was begun in February laſt, and the author, in order that gentlemen might have an opportunity of altering their hothouſes before the general forcing ſeaſon, had agreed with the printer and engraver that they ſhould execute their departments in a fortnight or three weeks. A promiſe which very unfortunately they have been unable to perform.

Juſt when the author had begun the work, he was called to the weſt of Scotland, and in order to ſupply the preſs with copy, he was under the neceſſity of making the ſketches, and writing great part of the *account* in the inns where he occaſionally ſtopped;

ſtopped; and of ſending off the manuſcript in detached portions to the printer. This accounts for the hurried and careleſs manner in which the whole is written; and alſo for a number of typographical errors which the author regrets exceedingly—Some of theſe which materially affect the ſenſe are noticed in the errata; but others, ſuch as thoſe in page 129, lines 5 and 6, page 163, line 15; page 158, line 8; page 186, foot note, *&c.* occur ſo frequently, that nothing can be done but intreat the reader's forgiveneſs.

Here alſo the author takes an opportunity of mentioning, that though he has ſtated in page 122, that the plants in Dickſons' and Shade's hothouſe after the improvements were made, " never ſuſtained *the leaſt* damage"—which was true at the time the work was written—yet ſome weeks ago, owing to a ſmall hole having been made in the ſmoke-flue, the ſmoke entered the houſe,

and

and almoſt killed two or three of the plants which were neareſt the hole.—But this is an accident totally unconnected with the nature or effect of the improvements, and therefore cannot injure their utility in the leaſt degree. It is only taken notice of here, becauſe ſome who are unwilling to approve of the ſcheme have endeavoured to report otherwiſe, and thus to prejudiſe thoſe who have not an opportunity of examining Dickſons' and Shade's hothouſe themſelves. The author reſts ſatisfied, however, that nothing of this kind will affect the mind of any candid reader. The plants injured were completely recovered in a few days, and continue in perfect health and luxuriance.

The following particulars deſerve alſo to be taken notice of in this place.

1. The author has erected a vinery ac-

cording to this plan, at —— Smith's, Esq. Leith-Walk.

In this case, it was necessary to build the furnace in one end of the house, to preserve both it, and part of the flue, under the ground level, and also to make the flue of the broad low kind, as shewn in fig. 3. plate II.—to render this as clear as possible, models are also made, which gentlemen may have recourse to, should they find any difficulty in making their workmen comprehend the principle of these furnaces, which is necessary in some degree so as they may be able to vary them agreeably to different situations.

2. The author has also used his *improved furnace*, in the case of a hotwall at Mr Smith's, which he thinks will be a very beneficial improvement. The vacuity as in the case of hothouses, is carried round the furnace, but in place of entering an air-flue

flue at the throat of the ſmoke-flue, it there enters the ſmoke-flue itſelf, and thus the heated air is carried along with the ſmoke, and like it gives out its heat to the walls.

3. At Col. DUNCAN's, Glenſuir, near Falkirk, he has alſo erected a pit according to his new plan, which is anſwering the purpoſe of growing cucumbers excellently. From this caſe, and other circumſtances, the author is induced to think, that this kind of pit will be a great benefit to gentlemen, by ſaving *time*, *riſk*, and *dung*.

The ſaving of dung, he thinks, will be of great advantage, in two ways.

1ſt, Becauſe it is well known among farmers, that dung, when kept ſo long as to be rotted into a ſolid black maſs, (like old peat,) as is always the caſe with that uſed in hotbeds, cannot be applied to the ſoil, with half ſo much advantage as when in an earlier ſtage of putreſcency.

2dly, The

2dly, The dung ſaved from hotbeds, in places where peat moſs abounds, (and there are few places where it cannot be come at,) if formed into compoſts as directed by Lord MEADOWBANK, * would produce three times the quantity of manure, the firſt ſeaſon in which the pits were adopted. This large increaſe of manure would produce the means of decompoſing a greater proportion of peat moſs than formerly. In this ratio might the improvement go on, and the conſequences would be of very great advantage to many gentlemen farmers; and it is preſumed, in ſome degree to the public in general.

That pits upon this principle may be clearly underſtood, either for the purpoſe of erecting larger or ſmaller ones, the author has cauſed to be made a model of the one delinated in plate VII. which clearly ſhews

the

* See the Highland Society's tranſactions.

the flues, ruble ſtone vacuity, ſteam and air tubes, &c. and alſo the form of curtains, and the mode of placing them ſuitable for pits or hotbeds. Owing to the additional trouble and nicety in forming this model, it became neceſſary to charge a higher price for it than for the others.

Theſe models are fully deſcribed in the letter preſs explanations which accompany them.

FINIS.

APPENDIX.

DESCRIPTION

OF THE

MODELS

OF THE

FURNACE, FLUES, INNER ROOFING, AND NEW PIT.

SOLD BY

Dicksons and Shade, Edinburgh; and Mr Dalziel, 4 Chapel-Street, Bedford-Row, London.

EXPLANATIONS

OF THE

MODELS.

MODEL FIRST.

SCALE ONE FOOT TO AN INCH.

The improved furnace, fuel-chamber, smoke and air-flue, according to the mode adopted in Dicksons and Shade's hothouse: and which is suitable wherever the front flue may be made four feet deep, as is frequently the case in vineries, and almost always in pine stoves, made in the ordinary manner.

The models are made of wood, and the principal parts marked by letters. These parts may be taken off in the order in which they are described.

A Repreſents the front wall: or, if the furnace were placed in the back part of the hothouſe, it would repreſent the end wall.

B When taken off diſcovers the fuel-chamber and aſh-pit—the vacuity round the fuel-chamber, and the two holes, *a a*, which communicate with the double furnace doors and that vacuity.

N. B. The furnace and aſh-pit doors could not be ſhewn owing to the ſmallneſs of the ſcale. But any maſon upon inſpecting this model, and the furnace itſelf, or even the views given, plate I. fig. 1. and 2. will find no difficulty in conſtructing it. The furnace may be ſeen either at Mr Dalziel's, London, or at Meſſ. Dicksons and Shade's, Edinburgh, and may be purchaſed from the Edinburgh Foundry Company.

C The cover of the air-flue and vacuity, which taken off, ſhews the large open ſpace

ſpace *b b* above, and near the furnace, and alſo the three holes *c c*, which communicate with the air-flue.

D The air-flue which is always continued along the top of the front flue from the furnace, to the oppoſite end of the houſe, and according to its length has three or more regiſters fixed in it, in order to regulate the heated air with preciſion. This improvement was not thought of when Dicksons and Shade's hot-houſe was altered, and was therefore not mentioned in the Treatiſe; it has ſince been adopted in Mr Smith's vinery, mentioned in page 248. The air-flue being taken off, ſhews the ſmoke-flue—its communication with the fuel-chamber at one end, and the partition at the other. Theſe partitions in deep flues, ſuch as theſe, are introduced every ten or twelve feet aſunder; but at a greater diſtance in broad ſhallow flues; (ſee Deſcription

cription of Model II.) By confining the ſmoke and heat, and promoting the draught, they are of great ſervice. See the Treatiſe, p. 40,-1,-2.

E The ſmoke-flue which, when taken off, diſcovers the ſupports *d d*.

F When taken off, ſhews the arch over the fuel-chamber, and the vacuity around it.

G The arch of the fuel-chamber, which, being taken off, ſhews the grate and the receſs for containing live-fuel.

H Being moved downwards, ſhews the vacuity under the receſs, which communicates with the air-flue.

I May repreſent the floor of the houſe: But if the ground be dry, the flue, (in pine-ſtoves at leaſt,) may be ſunk one half or more under the floor, or it may be even wholly ſunk, and the cover of the air-flue made the paſſage or walk. Such variations will naturally preſent themſelves to every ingenious gardener.

MODEL SECOND.

SCALE ONE FOOT TO AN INCH.

The improved furnace, fuel-chamber, smoke and air-flues, according to the mode suggested in plate II. by fig. 4. suitable for the front flues of Vineries, Peach-houses, &c. being nothing more than a variation of Model I.

A May either represent the front or end wall of the house, according to the situation of the furnace.

B When taken off discovers the fuel-chamber and ash-pit, and the two holes *a a*, which communicate with the double furnace doors, and that vacuity.

C Cover of the air-vacuity.

D Pipe for conveying the heated air used in place of a flue as it is cheaper in this case.

d Communication

d Communication between the air vacuity and air-flue.

E Smoke flue.

e Partition in the ſmoke flue, made as ſhewn in plate II. fig. 5.

g g The ſupports of the ſmoke flue.

H When taken off ſhews,

I The arch over the fuel-chamber.

K Grate.

L Receſs for containing live-fuel.

M Being moved downwards ſhews under this receſs, and the throat of the ſmoke flue, a vacuity for heated air, which communicates with the air-flue.

N. B. The arch over the fuel-chamber, and the throat of the ſmoke flue ought to be built with fire bricks and fire clay; and in building the flues, a ſtone about a foot ſquare ought to be built in the brick work at each part, where it may be judged moſt convenient to make an opening to cleanſe them from ſoot. In flues ſuch as

Model

Model I. this will generally be on thoſe parts of the ſides which are oppoſite to the partitions. In broad flues ſuch as Model II. they will be moſtly made in the top, by taking off one or more of the corners. In the improved pit, Model V. by making openings from the top, at the corners 1, 2, 3, 4, 5, 6, 7, 8. the whole may be cleanſed with eaſe. Ropes may be either puſhed through by rods or drawn by a cord, which cord may be previouſly drawn through by a cat, as was practiſed at Dalry.

MODEL THIRD.

SCALE TWO FEET AND A HALF TO AN INCH.

The Inner-roofing according to the mode ſhewn in plate III. and nearly as adopted in Dickſons and Shade's hothouſe, preferable in

 pineries

pineries or peach-houses, when no vines are trained immediately under the sloping glass.

The cord *B* used to draw up the curtain being loosed, it is pushed down by applying a small hooked rod, to the cross piece of wood *A*. Often, however, their own weight will accomplish this purpose, without any thing else being done than merely loosening the cords. A cord, however, may easily be contrived to draw down each curtain, when it is thought necessary.

The overlays, rings, and hooks, as mentioned in the Treatise, are easily seen in these curtains.

The end curtain is seen exactly as described in the Treatise. *C* is intended to represent the rack pulleys for rolling it up. A small rod appears, by which it is drawn out; and on that being done, another appears, which is intended to stretch the curtain to the

the proper height. A ſlit is alſo ſeen oppoſite the door, &c. as mentioned in the Treatiſe.

MODEL FOURTH.

SCALE TWO FEET SIX INCHES TO AN INCH.

The Inner-roofing as ſhewn iu plate IV. ſuitable for vineries and all ſorts of hot-houſes where fruit-trees are trained immediately under the ſloping glaſs.

The end curtain is drawn out by the ſmall upright rod, ſeen in the model, and rolled up by the cord at *A*. This cord paſſes over the pulley *B*, which is intended to repreſent a rack pulley. The other particulars mentioned in the Treatiſe reſpecting this curtain are eaſily ſeen without any minute explanation, ſuch as the ſlit oppo-

ſite the door for the operator to paſs out by when he has let down the inner-roofing, and the rods for keeping the curtain ſtretched to its proper height, &c.

In the diminutive bulk of a model ſuch as this, the curtains may be puſhed down by taking hold of the ſmall rods *C C*. But in a real hot-houſe this is intended to be done by the rod and hook already mentioned in the proper place. However it will frequently happen, that they will fall down with their own weight, when aſſiſted by turning round the rack pulley in a proper direction for this purpoſe.

A few wires are put in to repreſent a trellis for training vines upon, merely to ſhew that they can be done in connection with the inner-roofing. The uprights by which are ſupported both the trellis and the wires, upon which the curtain ſlides, are intended to be made of wood, and joined together at the top, as explained in the Treatiſe, and

and ſhewn in plate IV. fig. 3. but this is ſo plain that it is unneceſſary to ſay any thing here reſpecting it. The trellis can alſo be ſupported by props, or by a range of ſmall columns in the middle of the houſe, if found requiſite.

From the ſmall ſize of theſe models, the inner-roofing appears to take up much more room than it really does when executed upon the proper ſcale. For the ſame reaſon, a greater nicety is requiſite in rolling it up and down. But notwithſtanding theſe diſadvantages they ſerve the intended purpoſe as completely as can reaſonably be expected.

Price of theſe four Models, one guinea each.
Price of the following Model, three guineas.

MODEL FIFTH.

SCALE TWO FEET SIX INCHES TO AN INCH.

A PIT in which cucumbers, melons, pines, &c. may be grown; and roſes, flowers, ſtrawberries, aſparagus, &c. forced at the ſame time, or which may be wholly devoted to one or more of theſe articles at pleaſure; it being divided into one or more compartments, which may be kept of the ſame, or of different temperatures; ſee pages 178 and 234. A pit of this kind upon a ſmaller ſcale, was erected at Glenfuir, near Falkirk, in April laſt, and has ſince anſwered well.

A Excavation for containing fuel, and for managing the furnace, &c. This muſt be joined to the pit at *a a.*

B B Rafters

B B Rafters and coping which (in the model) are to be taken off: And, which bring off with them a part of the inner-roofing, made to ſhew the kind of curtains, and mode of fitting them up, ſuitable for pits and hot-beds. It alſo brings off the chimney tops, in which at *b b*, the dampers are fixed.

C C C Are the paved coverings of the large vacuity, for heated air. Above this vacuity, all over the ſurface are ſpread, firſt, ruble ſtones, ten or twelve inches in depth; above them, gravel, then a thin layer of ſand; and laſtly, the earth or mould in which is placed the plants, either in pots, or inſerted in the earth, as is done in the open air. This paved covering may be made in the rudeſt manner; for though their be interſtices between the ſtones, they will ſerve to admit the heated air from the vacuity, and if the ſtones be very thick, they will

will preſerve the heat, ſo much longer when once heated.

d d Round tubes, which are intended to be made ſquare, and to have ſmall pluggs or ſtoppers fitted to them; one half of theſe tubes communicate with the ruble ſtone vacuity, and the other half (alternately) with the large vacuity below. From both theſe vacuities, ſupplies of heated, or moiſt air may be obtained at pleaſure, as mentioned in the Treatiſe.

e e Holes in the back wall, by which water may be poured into the ruble ſtone vacuity.

f f Tubes for admitting heated air from the air-flue, by which, in connection with the valves at the throats of the two ſmoke flues, the diverſities of temperature are produced.

G G Part of the back wall, which may be taken off.

H H, &c.

H H, *&c.* Part of the two ends, and two of the divisions which may next be removed.

I Front wall, which may be taken off.

K Covers of the air-flue, which being taken off, shews its length.

k Supports of the pavement coverings, placed above all the flues.

l l Supports of the pavement coverings, built of brick on edge, as shewn plate IX. fig. 7. and plate VII. fig. 4.

M M Front smoke-flue, which taken off brings along with it the ends *m m*, which proceed from the furnace. The covers of this flue being taken off, shew the proper mode of making the partitions as at *n n*.

N N The cover of the air vacuity, which wholly surrounds the furnace, and part of the smoke-flue, until it enter the air-flue.

O Central division which may be next taken off.

 P P Covers

P P Covers of the excavation to the furnace, &c.

A The walls, &c. of this excavation may now be taken off in order to ſhew the furnace.

Q Being taken off ſhews the arch over the fuel-chamber.

R This arch which taken off, ſhews the grate, the receſs for live-fuel, and the throats of the two ſmoke flues which proceed from it.

S S The beginning of the ſmoke flues, where a common furnace door, with a handle is fixed on each throat, to ſerve as valves for regulating the admiſſion of the ſmoke and heat. See p. 181,-2.

T T Ground level.

The reſt of them might be taken to pieces, and alſo the ſupports of the pavements taken out; but what has been already deſcribed is fully illuſtrative of the whole, and any other particular may be fully underſtood by recurring to the plan.

Though

Though this pit be recommended for pines, cucumbers, &c. yet by avoiding to erect any thing in this model, except the air and ſmoke flues, and by introducing a trellis about eighteen inches from the glaſs; the quadruple compartments will make four excellent vineries which may be brought into fruit, at the ſame number of periods. The general principle of forming vineries in this manner, will be found to anſwer equally well with thoſe in common uſe, (as may be ſeen in ſeveral places in England,) and they may be executd at firſt for leſs than one half the expence.

This model will ſerve in connection with plate VI. fig. 2. fully to elucidate the plan recommended for growing pine-apples: were theſe in general altered agreeably to this plan, in moſt caſes they would produce one third more fruit annually than they do at preſent.

END OF THE APPENDIX.